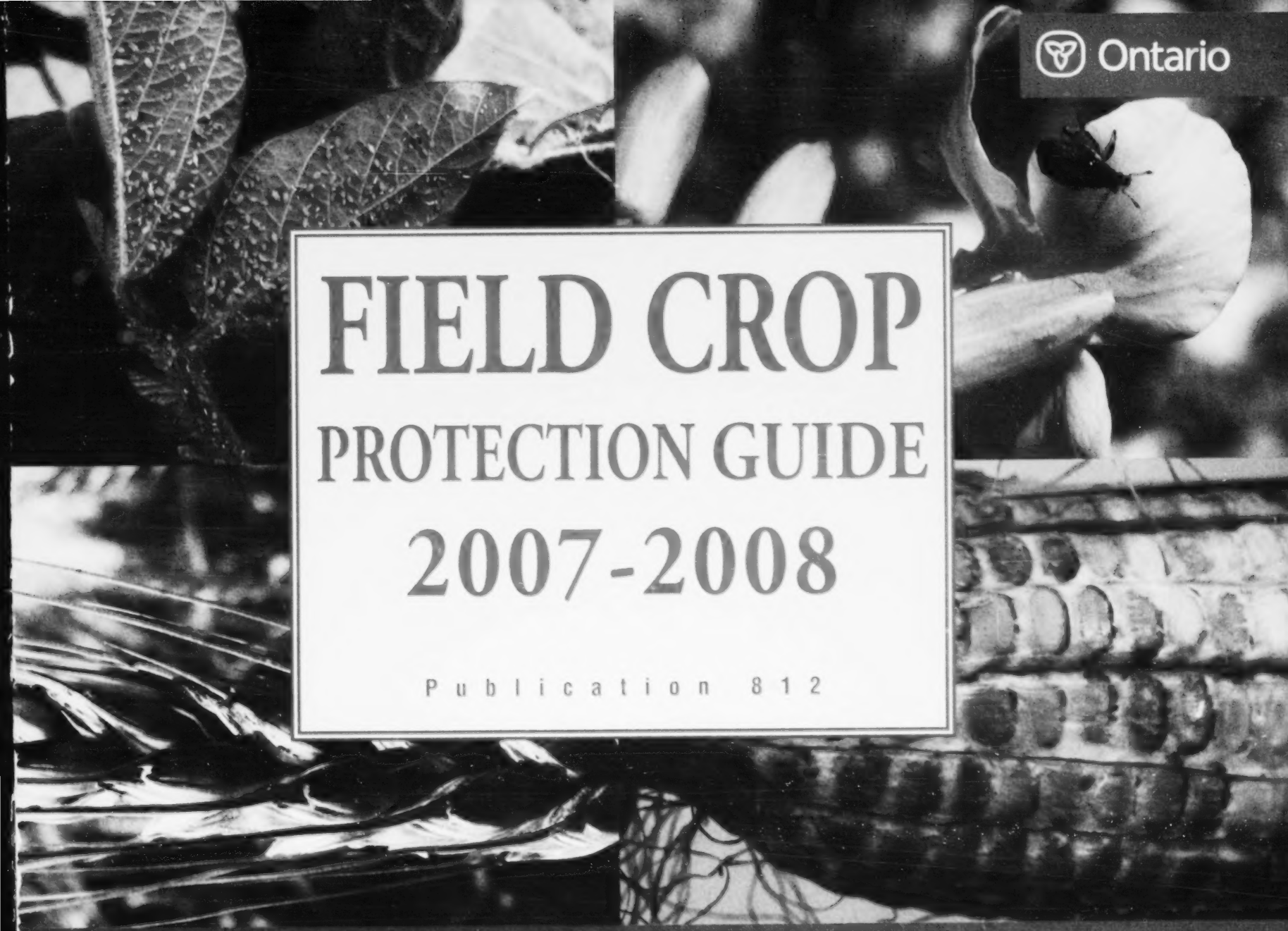


Ontario

FIELD CROP PROTECTION GUIDE 2007-2008

Publication 812

MINISTRY OF AGRICULTURE, FOOD AND RURAL AFFAIRS

Discard old editions of this publication. Each year the appropriate sub-committee of the Ontario Pest Management Research and Services Committee reviews the pesticides listed in this publication. To the best knowledge of the committee, at the time of printing, the pesticide products listed in this publication were:

- federally registered
- classified by the Ministry of Environment.

The information in this publication is general information only. The Ministry of Agriculture, Food and Rural Affairs does not offer any warranty or guarantee, nor does it assume any liability for any crop loss, animal loss, health, safety or environmental hazard caused by the use of a pesticide mentioned in this publication.

This publication lists a number of brand names of pesticides. It is neither an endorsement of the product nor a suggestion that similar products are ineffective.

The Pesticide Label

Consult each product label before you use a pesticide. The label provides specific information on how to use the product safely, hazards, restrictions on use, compatibility with other products, the effect of environmental conditions, etc.

The pesticide product label is a legal document. It is against the law to use the product in any other way.

Federal Registration of Pesticide Products

The Pest Management Regulatory Agency (PMRA) of Health Canada registers pesticide products for use in Canada based on following an evaluation of scientific data to ensure that the product has merit and value; and the human health and environmental risks associated with its proposed use are acceptable.

1. **Full Registration**
   Pesticide registrations are normally granted for a period of five years, subject to renewal.
2. **Temporary Registration**
   Temporary registration may be granted for a period not to exceed one year, where the registrant agrees to produce additional scientific or technical information, or the pesticide is used for emergency control of a serious pest outbreak.

Maximum Residue Limits

Health Canada has established maximum residue limits (MRLs) for pesticides. Processors or retailers may demand more restrictive limits. Growers should seek advice of their intended market to determine if more restrictive limitations apply. Keep accurate and up-to-date records on pesticide use in each crop.

Supplemental Labels

You MUST obtain a supplemental label and follow all the label directions when PMRA approves new uses for a registered pesticide that do not appear on the current label.

Examples of when you must use a supplemental label include:

- **Temporary Registrations for Emergency Use**
- **Minor Use Label Expansion**

You can obtain a copy of a supplemental label from the pesticide manufacturer or pesticide vendor, the grower association that sponsored the emergency registration or minor use, from OMAFRA or PMRA's Pest Management Information Service.

For more information on the federal registration status check the PMRA website at *www.hc-sc.gc.ca/pmra-arla* or call 1-800-267-6315.

Regulation of Pesticides in Ontario

The Ministry of the Environment is responsible for regulating pesticide sale, use, transportation, storage and disposal in Ontario. Ontario regulates pesticides by placing appropriate education, licensing and/or permit requirements on their use, under the *Pesticides Act* and Regulation 914.

All Pesticides must be used in accordance with requirements under the *Pesticides Act* and Regulation 914. The act and Regulation are available on the e-laws website at *www.e-laws.gov.on.ca* or call Publications Ontario Toll-Free number: 1-800-668-9938 or 416-326-5300.

Classification of Pesticides

The Ontario Pesticides Advisory Committee (OPAC) is responsible for reviewing and recommending to the Ministry of the Environment, the placement of pesticide products into one of six schedules used to control sale and use. Once approved by the Ministry of the Environment, classified products are posted on the OPAC website: *www.opac.gov.on.ca*. For more information call OPAC at 416-314-9230.

Certification and Licensing

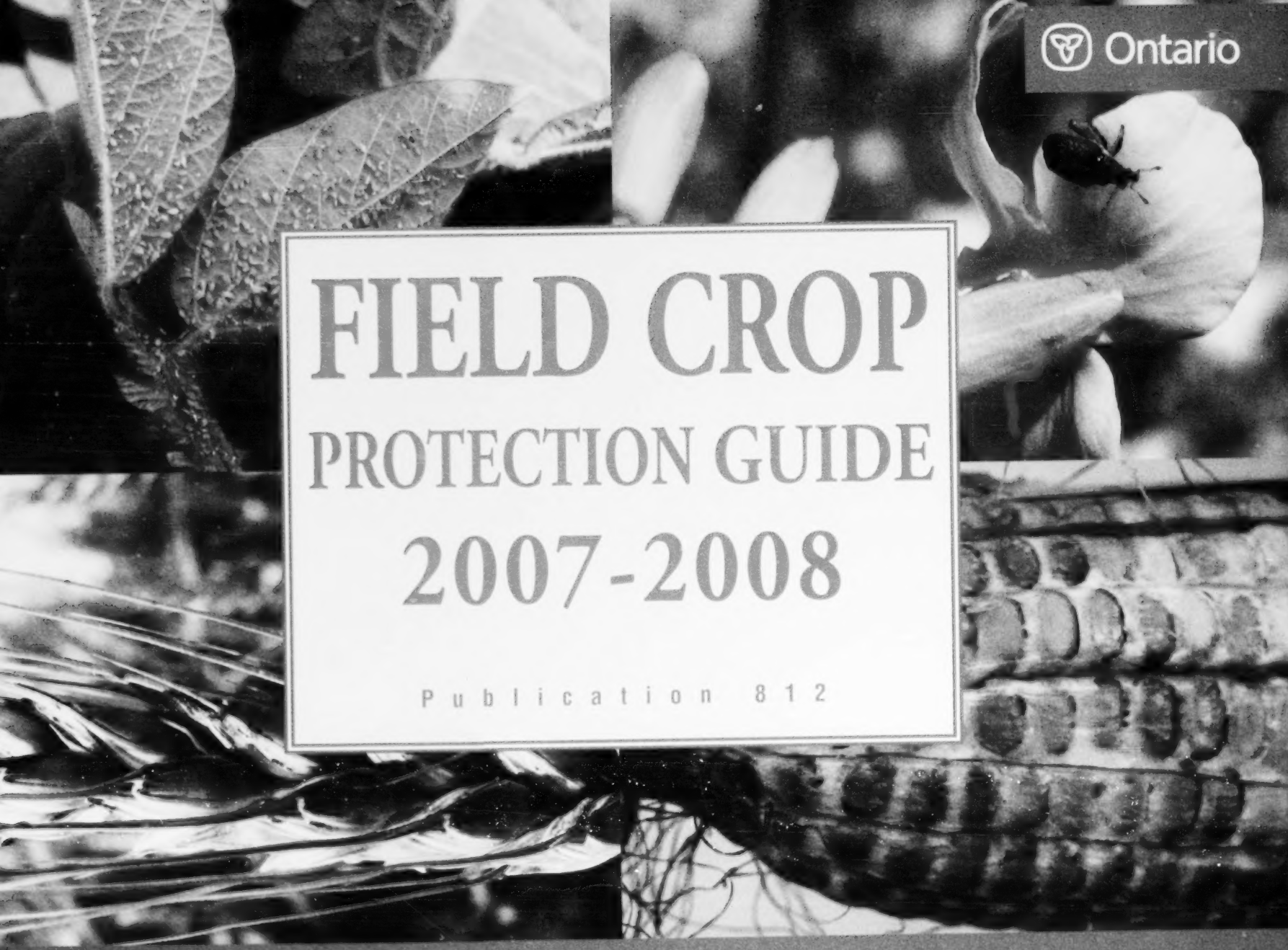
Growers and their Assistants

For information about certification for growers and training for assistants check the Ontario Pesticide Education Program website: *www.ridgetownc.uoguelph.ca/opep/* or ca 1-800-652-8573.

Commercial Applicators and their Assistants

For more information about exterminator certification and licensing and technician training check the Ontario Pesticide Training & Certification website at *www.ridgetownc.uoguelph.ca/optc* or call 1-888-620-9999.

Cette publication est aussi disponible en français.



Ontario

FIELD CROP PROTECTION GUIDE 2007-2008

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MINISTRY OF AGRICULTURE, FOOD AND RURAL AFFAIRS

Acknowledgements

The recommendations contained in this publication have been supplied under the direction of the Field Crop Protection Subcommittee, a subcommittee of the Ontario Field Crop Research and Services Committee, and the Ontario Pest Management Research and Services Committee, Crop Specialists of the Agriculture Development Branch, OMAFRA, University of Guelph, Ridgetown Campus, and Agriculture and Agri-Food Canada.

Need technical and business information?

Contact the Agricultural Information Contact Centre at
1-877-424-1300
or ag.info.omafra@ontario.ca

Looking for field crop production information on the Internet?

Check the OMAFRA website at:

ontario.ca/omafra

It's one-stop shopping for factsheets, articles and photos regarding the production and maintenance of field crops.

This publication contains all pesticide products and IPM strategies recommended by OMAFRA for the control of major field crop pests of Ontario. For information related to production, harvest, storage and pest life cycles, identification and other management strategies, see the *Agronomy Guide for Field Crops*, OMAFRA Publication 811.

Cover Images

FRONT TOP LEFT: Soybean aphids on soybeans
TOP RIGHT: Cabbage seedpod weevil in canola
BOTTOM LEFT: Wheat leaf rust
BOTTOM RIGHT: Gibberella ear rot

BACK BACKGROUND: Poorly emerging corn field due to wet soil conditions and soil insect feeding
MIDDLE INSET: Damaged corn seed with an immature wireworm inside

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Introduction

Understanding How Products are Listed in this Book

Only products **recommended** for use by the Field Crop Protection Subcommittee are listed in this book.

Placement of products under each pest is based on three criteria:

- Efficacy (effectiveness at controlling the pest)
- Safety to the user
- Safety to the environment
  - Biological options
  - Reduced risk options
  - Compatibility in an Integrated Pest Management program
  - Safety to beneficials

When two products have similar efficacy against one pest, the product that displays a lower risk to both the environment and the applicator will appear first in the recommendation list.

Newly registered products are generally placed on the bottom of the recommendation list, unless research has proven that the product is superior to the other products already listed under that pest and crop.

Resistance Management Strategies

Different pesticides control pests in different ways. This is called the mode of action. Pesticides are grouped into chemical families/groups based on their mode of action. Using the same pesticide with the same mode of action season after season or several times within the same season could result in that pest becoming resistant to the chemical family. A pest can develop resistance to one chemical family but still be very susceptible to another. Therefore, to reduce the risk of a pest developing resistance, rotate between chemical groups/families within the same season or during successive growing seasons for control of the same pest. For example, if using a Group 11 fungicide (e.g., Quadris) to control rust in corn, and more than one application is required that season to manage the disease, use a product from a different group (e.g., Tilt fungicide, which is a Group 3 fungicide) for the second application, because it controls the disease using a different mode of action. Pesticide labels indicate which chemistry group or family that product belongs in. For a list of insecticide and fungicide chemical groups, see Appendix H, *Pesticide Groups Based on Sites of Action*, on page 86.

Only use chemical control when necessary and consider implementing other forms of control such as cultural control (e.g., crop rotation, use of certified seed) or biological control to help reduce the risk of a pest developing resistance to a pesticide.

Do not exceed the total number of applications allowed per year for each product. Do not apply the product at rates lower than the recommended rate on the label.

Monitor recently treated pest populations for signs of resistance.

See the pesticide label for more information on resistance management. For more information on resistance management strategies or integrated pest management (IPM) options for a specific pest, contact your local OMAFRA extension specialist or certified crop advisor. IPM options are listed in the first column of the Chemical Control Options tables in this publication.

1. Precautions With Pesticides

When you decide to use a pesticide, choose the best formulations and application methods for the situation. Take all possible precautions to prevent the exposure of people and non-target organisms to the pesticide. To limit the negative impacts of pesticides:

- Select the least-toxic pesticide that will do the job. The pesticide recommendation tables included throughout this book rank registered products based on efficacy, user toxicity and environmental impact.
- Use application methods that minimize pesticide drift or spread in the environment.
- Use only a properly calibrated sprayer.
- Use spot treatments to limit treatments to only the plants or fields where pests are a problem.
- Take precautions to prevent exposure of humans and non-target organisms to pesticides.

Pesticide Regulations

Federal Laws

Before a pesticide can be sold or used in Canada, it must be registered under the *Pest Control Products Act* (PCP Act). The PCP Act registration number on the front panel of the label identifies the pesticide and tells you that the pesticide can be legally used in Canada. The pesticide label is a legal document. It tells you how the pesticide can be legally used. Off-label use is illegal. It is against the law to use the pesticide in any other way or on any other crop or pest. You can find the labels for all registered pesticides on the Pest Management Regulatory Agency website: www.hc-sc.ca/pmra-arla.

Ontario Laws

In Ontario, pesticides are regulated by the *Ontario Pesticides Act* and Regulation 914. You can find a copy of this Act and Regulation at www.e-laws.gov.on.ca. For information about Ontario pesticide laws and regulations, contact your regional Ontario Ministry of the Environment Pesticides Specialist or see the Ontario Ministry of the Environment website at www.ene.gov.on.ca. See Appendix D, *Ontario Ministry of the Environment Pesticide Control Offices*, on page 82.

You must report all major spills, fires or thefts involving pesticides to the Ontario Ministry of the Environment at: 1-800-268-6060.
(Regulation 914, s. 29)

Pesticide Schedules in Ontario

The Ontario Pesticide Advisory Committee is responsible for reviewing and recommending the placement of pesticide products into one of six schedules used to control the sale and use of the pesticides. See Table 1–1, *Ontario's Pesticide Classification Schedules*, on page 4.

Certification and Training Requirements

You must be a certified grower or a licensed applicator (exterminator) to buy and use Schedule 1, 2 or 5 pesticides. Assistants may also use these pesticides if they are trained and supervised as required.

Pesticide Certification for Ontario Farmers

Regulation 914 of the *Pesticides Act* requires that agriculturalists (growers) be certified to buy and use Schedule 1, 2 or 5 pesticides on land they farm. To become certified, agriculturalists must:

- attend the Grower Pesticide Safety Course (GPSC) and successfully complete the examination,
  AND
- meet the definition of an "agriculturalist" as defined by Regulation 914 under the *Pesticides Act*, (i.e., use farmland for agricultural or forestry production, and that land falls within the farmlands property class under Section 7 of the *Ontario Assessment Act*),
  AND
- be at least 16 years of age.

Training for Agricultural Assistants Using Schedule 2 or 5 Pesticides

All assistants must have formal pesticide safety training that is recognized by the Ministry of the Environment, before they can handle or use Schedule 2 or 5 pesticides under the supervision of a certified grower.

- This applies to all assistants, including family members, farm employees and seasonal workers.
- Trained assistants do not have to write an exam.
- Trained assistants must be 16 years of age or older.
- There are two training options for assistants. Assistants can:
  - attend a Grower Pesticide Safety Course and not write the certification examination,
    OR
  - attend an on-farm training session presented by a qualified trained assistant instructor.

Table 1–1.
Ontario's Pesticide Classification Schedules

Sch.	Human and/or Environmental Health Criteria[1]	For Use According to Label Directions By:				
		Licensed exterminator	Certified grower	Trainee/ technician	Trained assistant	Property owner or tenant
1	very toxic very persistent	✓ (under permit)	✓ (under permit)			
5	very toxic very persistent	✓ (aerial application under permit)	✓		✓ (under supervision)	
2	toxic persistent	✓	✓	✓ (under supervision)	✓ (under supervision)	✓ (aquatic herbicides, under permit)
3	moderately toxic moderately persistent	✓	✓	✓ (under supervision)	✓	✓
4	low toxicity low persistence	✓	✓	✓ (under supervision)	✓	✓
6	low toxicity low persistence (larger container)	✓	✓	✓ (under supervision)	✓	✓

[1] More detailed information on classification criteria is outlined in the OPAC guidelines for classification of pesticide products available at www.opac.gov.on.ca.

To register for a Grower Pesticide Safety Course anywhere in Ontario, or for more information on training and certification requirements:

- call: 1-800-652-8573
- fax: 1-519-674-1589
- e-mail: opep@ridgetownc.uoguelph.ca or
- visit the Ontario Pesticide Education Program website at: www.ridgetownc.uoguelph.ca/opep/

Certification and Licensing for Commercial Pesticide Exterminators

If you plan to apply pesticides as a business, you must be a licensed exterminator.

This includes farmers who custom-apply pesticides for other farmers and charge a fee for this service. Licensed exterminators who are self-employed must hold an operator licence as well as the appropriate exterminator licence. Exterminator licences are valid for 5 years.

To become a licensed exterminator, you must:

- complete a home study course and certification exam through University of Guelph, Ridgetown Campus,

AND

- send proof of certification (letter of successful completion of the exam(s)) and a fee to the Ministry of the Environment to obtain your exterminator licence

Training for Technicians Working as Assistants to Licensed Exterminators

Assistants to licensed exterminators must become technicians to mix, load or apply all Schedule 3, 4 and 6 pesticides and most Schedule 2 pesticides (some restrictions apply), under the indirect supervision of a licensed exterminator. Technicians cannot mix, load or apply Schedule 1 or 5 pesticides. Technician cards are valid for 2 years.

To become a technician, you must:

- complete an MOE-approved academic course and exam,

AND

- complete practical training with a licensed exterminator

For updates to training requirements under Regulation 914 of the *Pesticides Act*, see the Ministry of Environment website at www.ene.gov.on.ca or phone 1-888-565-4923.

General Precautions

Always read the label first!

- before you buy a pesticide
- before you begin to use a pesticide
- before you store a pesticide or dispose of it

Learn about the health hazards and toxic properties of the pesticide you are using. Consult the product label, Material Safety Data Sheet (MSDS) or manufacturer for this information. Check the company websites for MSDS information (see Appendix A, *Manufacturers of Pesticides Recommended in Publication 812*, on page 77.)

Protect Yourself When You Use Pesticides

- Make sure someone knows where you are working, what pesticides you are handling and how long you expect the job to take.
- Post emergency numbers, including the Poison Information Centre and Spills Action Centre, near all of your telephones.
- Keep a list of the names and the *Pest Control Products Act* (PCP Act) registration numbers of all the pesticides you handle. Keep a file of the pesticide label booklets for all the products you use. Make sure that your co-workers and family members know where this list or file is in case of an accident.
- Have plenty of clean water, soap and paper towels — and an extra set of gloves and coveralls — nearby at all times, in case pesticide contaminates your clothing or skin.
- Wear the correct protective clothing and equipment, and be sure that all items are clean and in good repair before you put them on.
- Never smoke, chew tobacco, eat or drink when you handle pesticides. Never carry tobacco or food in your clothes — and never leave tobacco, food or beverages in areas where you handle or store pesticides.
- Change your clothes and wash your hands and face before you eat, drink or smoke.
- Wash your hands before you use the toilet, as well as after. The skin in your groin area absorbs pesticides very easily.

Protect Other People, Livestock, Pets, Water and Sensitive Crops

- Buy and store only what you need.
- Prevent drift.
- Keep pesticides out of water.
- Clean up spills quickly and safely.
- Dispose of containers and waste pesticide safely.

Human Health

Risks of Pesticide Use

Each time you handle a pesticide, you are at some risk. The amount of risk depends on two things — the toxicity of that pesticide and your exposure to it.

Risk = Toxicity x Exposure

Toxicity is a measure of how harmful or poisonous the pesticide is. There are two types of toxicity:

- **Acute toxicity** is the toxic response that results from a **single exposure** to the pesticide. The symbols and words on the front panel of a pesticide label give you information about the acute toxicity. See Table 1–2, *Relative Acute Toxicity Levels of Certain Pesticides*, right, for the toxicity levels of some products listed in this publication.
  - **Lethal Dose 50%** (LD_{50}) is a measure of acute toxicity. It is the dose (mg of product/kg of body weight) that will kill 50% of the test animals within a stated period of time (24 hours to 7 days). **Products with low LD_{50} ratings are highly toxic.**

Table 1–2.
Relative Acute Toxicity Levels of Certain Pesticides[1]

Use this table as a guide only.
See the pesticide label for specific information.

DANGER: POISON symbol high acute toxicity	**WARNING: POISON symbol** moderate acute toxicity	**CAUTION: POISON symbol** lower acute toxicity	**No poison symbol** very low acute toxicity
Agrox B-2	Apron XL LS	Botran 75 W	Allegiance FL
Agrox CD	Bumper 418 EC	Captan FL	Apron FL
Bumper 418 EC	Cygon 480	Cruiser 5 FS	Apron Maxx
Counter 15 G	Force 3.0 G	Cruiser 350 FS	Baytan 30
Decis 5 EC	Lagon 480 E	Gaucho 480 FL	Bravo 500[1]
DCT	Poncho 600	Gaucho CS	Captan FL
Furadan 480 F	Sevin XLR	Gemini	Dipel 2X DF
Headline EC	Thiram 75 WP	Helix Xtra	Dithane DG
Imidan 50 WP		Lance WDG	Dithane F-45
Lannate TNG		Lorsban 15 G	Dithane M-45
Matador 120 EC		Malathion 500 E	Dividend XL RTA
Pyrinex 480 EC		Pounce	Dynasty 100 FS
Thimet 15 G		Pyrifos 15 G	Folicur 432 F
Thiodan 4 EC		Quilt	Maxim 480 FS
Thionex EC		Raxil T	Prosper
		Ripcord 400 EC	Quadris
		Ronilan EG	Senator 70 WP
		Rovral	Sluggo
		Tilt 250 E	Stratego 250 EC
			Thuricide HPC
			Vitaflo 280

[1] Warnings about specific hazards such as corrosiveness, and skin or eye irritations, not included here, can be found on the product label.

- **Chronic toxicity** results from **repeated exposures** to small doses of a pesticide over a longer period of time. These toxic effects may not appear for months or years after exposure to the pesticide. The symbols on the label do NOT give information about the chronic toxicity of the product. Use protective clothing and equipment to help reduce exposure and the risk of chronic effects.

Exposure

Exposure is a measure of the contact you have with the pesticide. You can be exposed to the pesticide in three ways.

1. Dermal exposure occurs through your skin or eyes. The amount and rate of pesticide that may be absorbed depends on several things, including:
   - your skin condition. If your skin is moist, or if you have rashes, broken skin or scratches, pesticide will be absorbed more easily.
   - the part of your body that is exposed. Your eyes, genital area, scalp and ear canals absorb pesticides at a higher rate than your hands or arms. Your eyes absorb pesticides at a rate of 100%.
2. Respiratory exposure (inhalation) occurs when you inhale small spray particles, dust, gases or vapours.
3. Oral exposure occurs when a pesticide enters your mouth or when you swallow a pesticide.

Monitoring for organophosphorus and carbamate pesticide poisoning

If you handle or apply organophosphorus or carbamate insecticides on a regular basis, you should have regular cholinesterase blood tests.

The first test should be taken before you handle, use or have any exposure to these pesticides. That will show the normal level of cholinesterase in your body. Your doctor can arrange these tests for you. During the spray season, if you spray organophosphorus or carbamate insecticides regularly for several weeks, you should have a cholinesterase blood test every 7–10 days. If your cholinesterase level was affected during the spray season, you should have another cholinesterase blood test at the end of the season when you finish with these products. This test will show whether your cholinesterase levels are back to normal. See Table 1–3, *Pesticides Used in Field Crops that Affect Cholinesterase Levels in Blood*, right.

Table 1–3.
Pesticides Used in Field Crops that Affect Cholinesterase Levels in Blood

Common (active) name	Trade name
carbaryl	Sevin
carbofuran	Furadan
chlorpyrifos	Lorsban, Pyrinex, Pyrifos
diazinon	Agrox B-2, Agrox CD
dimethoate	Cygon, Lagon
malathion	Malathion
methomyl	Lannate
phosmet	Imidan
phorate	Thimet
terbufos	Counter

Pesticide Label Information

Learn about the health hazards and toxicity of the pesticide you use. Check the precautions section of the label for special warnings about eye and skin hazards. The front panel of the pesticide label may also contain warnings that the product is corrosive to eyes, or is a skin or eye irritant.

For more information on hazards, check the product label, Material Safety Data Sheet (MSDS) or manufacturer for this information. Check the company websites for MSDS information. See Appendix A, *Manufacturers of Pesticides Recommended in Publication 812*, on page 77, for company contact information.

Re-Entry Periods

Re-entry period is the minimum amount of time that must pass between the time the pesticide was applied and the time that workers can go into the crop area without wearing personal protective equipment. If workers enter treated areas without wearing protective equipment too soon after pesticides have been applied, they may experience poisoning. Such poisoning can result from handling treated plants or from inhaling pesticide vapours.

Know the Hazard Symbols and Words

Four important symbols and words show the potential hazards of pesticides.

Hazard Symbol	Signal Word
	Poison
	Corrosive
	Flammable
	Explosive

The hazard symbol always appears inside one of the shapes shown below. These shapes and their warning words tell you the degree of hazard of the pesticide. **The greater the number of sides to the shape, the more hazardous the product**.

	Warning Symbol	Signal Word
Triangular shape means low hazard (3 sides)		Caution
Diamond shape means moderate hazard (4 sides)		Warning
Octagonal shape means high hazard (8 sides)		Danger

Learn these symbols and words — they could save your life!

The list below shows a specific minimum interval that you must observe between applying the pesticide and working in the treated crop without protective equipment.

Pesticide	Re-entry period
cyhalothrin-lambda (Matador)	24 hours
methomyl (Lannate)	24 hours
carbofuran (Furadan)[1]	48 hours
pyraclostrobin (Headline)	48 hours

[1] If prolonged direct contact with corn foliage will occur, do not enter treated fields within 14 days of application without wearing protective equipment.

Some pesticides, such as parathion, have labels that carry a warning about working in treated crops. Follow the label recommendations.

Days to Harvest (Preharvest) Intervals, Pregrazing and Feeding Intervals

These intervals state the minimum amount of time that must pass between the last pesticide application and the harvesting of the crop, or the grazing or cutting of the crop for livestock feed. If you harvest a crop before the preharvest interval has passed, there may be pesticide residues in excess of the Maximum Residue Limits (MRL) set by Health Canada.

To avoid exceeding the Maximum Residue Limits, always follow the label.

Crop Rotation Statements

Some pesticides can persist in treated soil. Crops sensitive to that pesticide may be injured if they are planted too soon after the treated crop is harvested. Some labels state a minimum waiting time that must pass before it is safe to plant sensitive crops.

Always consult product labels for full label directions.

Protective Clothing and Personal Protective Equipment

Make sure your protective clothing and equipment:

- are what you need for the job
- fit properly
- are clean and in good repair and working condition

The protective clothing and equipment you will need depends on:

- the pesticide you are using — Read the precautions section of the label to know what to wear.
- the job you are doing — For example, you need more protection when you handle concentrated pesticide or when you mix and load your sprayer.
- the type of application — For example, enclosed space or air blast sprayer applications made with open tractors require more equipment.

Each person who is working with pesticides needs his or her own set of protective clothing and equipment. Consult the technical expert at your safety supply company to make sure that you purchase the appropriate equipment and that it fits the user. See Table 1–4, *Safety Supply Companies in Ontario Providing Protective Clothing and Personal Protective Equipment*, right, for a list of supply companies.

Clothing

For ALL pesticide applications, always wear:

- a water-repellent hat, such as a hard hat or waterproof rain hat. Do not wear hats made from cloth; they absorb pesticides and are not safe.
- long pants and a shirt with long sleeves or coveralls
  - Coveralls can be reusable or disposable. Reusable coveralls are normally cotton or polyester and should be tightly woven. Disposable coveralls should be designated for pesticide use.

Table 1–4.
Safety Supply Companies in Ontario Providing Protective Clothing and Personal Protective Equipment

3-M Canada Company	Occupational Health and Environmental Safety Box 5757 London, ON N6A 4T1	519-452-6165 1-800-364-3577 fax: 519-452-4660
Acklands Grainger	90 W. Beaver Creek Rd. Richmond Hill, ON L4B 1E7	905-731-5516 1-800-668-8989 fax: 905-731-2798
Aearo Canada	6889 Rexwood Rd. Mississauga, ON L4V 1R2	905-795-0700 1-800-387-4304 fax: 905-564-5250
Dutch Industries "Protect-Air Cab Filter"	Huron Tractor, Box 1300 Exeter, ON N0M 1S3	519-235-1115 fax: 519-235-1939
HAMILSCO	3392 Wonderland Rd. London, ON N6L 1A8	519-652-9800 1-800-668-9800 fax: 519- 652-9661
Dupont Personal Protection	20 Ryan Place Brantford, ON N3S 7S1	519-752-4369 1-800-387-9326 fax: 519-752-2161
Levitt-Safety (Eastern) Limited	2872 Bristol Circle Oakville, ON L6H 5T5	905-829-3299 1-800-668-6153 fax: 905-829-2919
MSA Canada	2800 Skymark Ave. Unit 33 Mississauga, ON L4W 5A6	905-602-0338 1-800-267-0672 fax: 905-238-4151
Mitt & Robe Co. Ltd.	751 Norfolk St. N. Simcoe, ON N3Y 3R6	519-428-4050 1-877-893-6565 fax: 519-428-5142
Plant Products Co. Ltd.	314 Orenda Rd. Brampton, ON L6T 1G1	905-793-7000 1-800-387-2449 fax: 905-793-9632
Safety Express	4060B Sladeview Cres. Unit 2 Mississauga, ON L5L 5Y5	905-608-0111 1-800-465-3898 fax: 905-608-0091
The St. George Company (Suppliers of Kasco Helmets)	P.O. Box 430 20 Consolidated Dr. Paris, ON N3L 3T5	519-442-2046 1-800-461-4299 fax: 519-442-7191

    - Water-resistant coveralls are preferred, because cotton, denim and cotton/polyester pants cling to the skin if they get wet, increasing the risk of dermal exposure.
- chemical-resistant gloves (unlined)
    - Use neoprene or nitrile gloves (PVC), unless the label states otherwise. Do not wear rubber gloves, as many pesticides can break down the rubber material. Wear your gloves under your sleeves with the top cuffed.
- chemical-resistant boots (unlined)
    - Wear your pant legs over your boots to prevent pesticide from running down inside your boots.

Read the label. It will describe what extra protective clothing and equipment to wear. For some pesticides you may also need to wear:

- goggles
    - Use safety goggles with indirect vents so that splashes do not enter your eye. Regular eyeglasses don't provide suitable protection. Never wear contact lenses when you handle pesticides.
- face shield
- chemical-resistant apron
- respirator
    - A respirator is a unit that covers your mouth and nose to prevent spray droplets, small particles and vapours from getting into your lungs. A dust mask is not a substitute for a pesticide respirator. Make sure you use cartridges and pre-filters that protect you against organic vapours. For more information about respirators, see the *Grower Pesticide Safety Course Manual*, University of Guelph, Ridgetown Campus.
    - You may need more protection, such as canister gas masks or a self-contained breathing apparatus (SCBA) when you apply:
- any pesticide in an enclosed area
- fumigants, gases, vapours or smokes
- water-repellent suit (rainsuit)

For more information about protective clothing and personal protective equipment, see the *Grower Pesticide Safety Course Manual*, available from University of Guelph, Ridgetown Campus, and through the Ontario Peticide Education Program website: www.ridgetownc.com/opep/.

Care of Protective Clothing

After you complete the spray operation, clean all protective clothing and personal protective equipment. Always remove protective clothing and equipment outdoors. If you were using a granular pesticide, shake out the clothing outdoors in a safe place, emptying pockets and cuffs.

Wash coveralls and other spray clothing separately from other clothes. Throw out clothing that has been contaminated by spills of highly toxic or concentrated pesticides. Put clothing in a plastic bag and take it to a landfill site.

Never let children, pets or livestock come in contact with contaminated clothing or equipment. Also make sure that they cannot come into contact with the puddles of water left over from cleaning your equipment.

For more information on the care and cleaning of protective clothing, see the *Grower Pesticide Safety Course Manual*, University of Guelph, Ridgetown Campus.

Use Organic Vapour Tractor Cab Cartridges

If you use a tractor with a cab when you spray, use tractor cab cartridges, which work the same way as an air-purifying respirator. These cartridges and pre-filters must be replaced on a regular basis to provide continued protection.

When you use air-blast sprayers and mist blowers and tractors without cabs:

- wear the appropriate respirator, as well as a waterproof suit, head covering, chemical-resistant gloves, boots and eye protection. Once you complete the spray application, clean your protective equipment and the tractor. Do not operate the tractor without wearing protective clothing and equipment, unless it has been decontaminated.

Personal Hygiene

Wash your hair and under your fingernails. Shower with lots of soap and water.

When you are finished for the day, take a bath or shower as soon as possible. The longer a pesticide remains on your skin, the greater the risk that it will be absorbed into your body.

Always wash your hands before you eat, drink or smoke.

Always change into clean clothes.

Wear clean work clothes every day. A small spill on the previous day's clothes may seem unimportant, but wearing the same clothing again without washing it prolongs the exposure and increases your risk.

Protect the Environment

Prevent Contamination of Adjacent Land and Water Bodies

Do not allow pesticides to drift, run off or leach onto land or water bodies bordering treatment areas. Leave a suitable buffer zone between the treatment area and adjacent areas. No spray droplets should fall on adjacent

properties, where treatments are not authorized. Areas of concern are:

- cultivated plants grown for human consumption
- plants sensitive to herbicide drift
- trees or shrubs that may be damaged by herbicides leaching to roots
- areas where children play

Buffer Zones

Buffer zones are vegetated areas, left untreated to protect an adjacent area, for example, a pond, a stream, a sensitive crop, a non-target crop, wetland or woodland, etc.

Setback Distances for Water Bodies

It is an offence under the federal *Fisheries Act* to introduce any material into water that may be harmful to fish or fish habitat. To protect these waters, landscape applicators must determine a suitable setback distance between the area to be protected and the area where pesticide treatments are planned. The protected area includes the water body, as well as adjacent riparian (riverbank) areas that contribute to fish food and habitat.

Protect Water Sources

- Use an anti-backflow device to prevent back-siphoning when drawing water from wells, ponds, streams or other sources.
- Mix pesticide and load the sprayer away from any water supply, including wells, ponds or streams.
- Use buffer zones (untreated areas) when you apply pesticides to avoid contaminating surface water, wells, ponds and/or streams, especially those containing fish. Check the product label for specific buffer zone recommendations. See the section *Setback Distances for Water Bodies*, above.
- Do not allow equipment rinse water and excess pesticides to run into sewers, drains or ditches with water in them. Rinse water should be put into spray tanks and applied to the treatment area. Otherwise, it must be disposed of as hazardous waste through a hazardous waste disposal company. For more information, see the section *Disposal of Pesticides and Empty Pesticide Containers*, on page 10.

Preventing Groundwater Contamination

Groundwater is the source of water for wells and springs. If groundwater becomes contaminated with pesticides, it is difficult to clean. Preventing groundwater contamination is crucial. Some pesticides have the potential to leach through the soil to groundwater.

Movement of pesticides into groundwater can make the water unfit for use. However, pesticides applied to the soil are subjected to physical, chemical and biological processes that affect their movement through the soil and their potential for groundwater contamination. Making the right pesticide choices for the situation can help minimize the threat of groundwater contamination.

Soil Characteristics

Soil texture plays a major role in pesticide performance and persistence. Soil organic matter can make a difference in pesticide activity. Therefore, it is important to select a pesticide based on soil type and organic matter content. Chemicals tend to leach more readily in coarse-textured soils with low organic-matter content. In contrast, fine-textured soils with high organic matter are highly adsorptive and therefore have a low leaching potential.

Pesticide Characteristics

Some pesticides bind strongly (adsorb) to soils and therefore are not easily removed. Clay materials and organic matter favour strong adsorption. Use soil analysis information on organic matter content when selecting pesticides and application rates for your pest management program. Some pesticides are highly soluble in water, which can increase their leaching potential. Leaching of a pesticide can be minimized by pesticide dosage and by the timing and method of application. Choose the right pesticide for your situation.

The rate of degradation by natural processes is highly dependent on both the pesticide class (chemistry) and environmental factors. Sunlight, temperature, soil, pH, microbial activity and other soil characteristics affect the breakdown of pesticide. Some pesticides break down slowly and therefore have a greater potential for leaching. A short-lived pesticide may be degraded before any leaching occurs. Choosing a short-lived pesticide can minimize leaching potential.

Microbial degradation occurs when fungi, bacteria and other soil microorganisms use pesticides as a food (energy) source. High organic-matter content, along with other properties such as optimum moisture, aeration, temperature and soil pH, can enhance microbial degradation. In addition, chemical degradation of pesticides can occur by reaction with water, oxygen and other chemicals. In general, pesticides that are highly water-soluble, relatively persistent and not readily adsorbed by soil have the greatest potential for leaching.

Water Table

High water tables may be vulnerable to contamination by pesticides and fertilizers due to the relatively short distance between the soil surface and groundwater. There is potential for groundwater contamination in areas with coarse-textured soils and high water tables.

Specific application information for each pesticide is contained on the pesticide label. Careful adherence to application and disposal directions, combined with proper equipment calibration, provide the best method of preventing groundwater contamination.

Reduce Pesticide Spray Drift

- Read the product label for information regarding buffer zones, water volumes and recommended nozzles.
- Use buffer zones around all watercourses and wells as well as neighbouring fields that contain sensitive crops. If the label does not state a specific buffer zone distance, leave an untreated area of natural vegetation.
- Select the recommended sprayer application rate (L/ha).
- Select the correct nozzle. Where practical, use air induction/venturi nozzles. These nozzles significantly reduce drift compared to conventional nozzles.
- Select the correct nozzle-to-target distance.
- If wind velocity exceeds 10–12 km/hr, suspend operation until the windspeed drops. If you notice drift is occurring because of the wind, stop spraying until the wind subsides. Do not apply pesticides if the wind is blowing towards susceptible crops or environmentally sensitive areas such as watercourses.
- Use spray plume protection where practical or available (hoods, shrouds, screens and air curtains).
- Use drift-reducing adjuvants in the spray tank as directed by the label.
- Use wick weeders, instead of spraying, when possible.
- Use non-volatile compounds.

For more information about spray drift, see:

- *Best Management Practices — Pesticide Storage, Handling and Application* (OMAFRA/Agriculture and Agri-Food Canada booklet)
- *How to Manage Spray Drift* (Ontario Pesticide Education Program (Ridgetown College) video)
- *Spray Drift Reduction Through Air Induction* (Ontario Pesticide Education Program (Ridgetown College) video)

Prevent Bee Poisoning

It is important to protect bees when you spray. Honeybees, as well as other bees and insects, are important pollinators of crops. Many crops also offer bees important sources of nectar for honey production.

If you choose to use insecticides for insect control, take these steps to prevent harming bees when you spray:

- Before you apply a pesticide, advise local beekeepers, so that they can move colonies out of the danger area. Contact the Provincial Apiarist at 1-888-466-2372 for a list of the beekeepers in your area.
- Do not spray any flowering crop on which bees are foraging. If you must apply insecticides, spray after 7 PM when the bees are not foraging. If this is not a possibility, spray before 7 AM. Bees usually do not forage at temperatures below 13°C (55°F).
- Do not apply insecticide on windy days to prevent drift toward any nearby hives.
- When there is a choice, choose the product formulation that is less hazardous to bees. Dusts are more toxic than sprays. WP formulations are more toxic than EC formulations.
- Under the *Bees Act*, it is an offence to spray in orchards while there is bloom on the trees.

Most organophosphorus and carbamate insecticides are highly toxic to bees. Examples of insecticides used in crop production that are very toxic to bees are listed in Table 1–5, *Relative Toxicity of Insecticides to Honeybees*, right.

Read each pesticide label for specific precautions regarding bees.

Table 1–5.
Relative Toxicity of Insecticides to Honeybees

Group 1 – Very toxic. Do not apply to flowering crops or weeds	
Basudin, Diazinon	diazinon
Cygon, Lagon	dimethoate
Furadan	carbofuran
Imidan	phosmet
Lannate	methomyl
Lorsban, Pyrifos, Pyrinex	chlorpyrifos
Malathion	malathion
Ripcord	cypermethrin
Sevin	carbaryl
Group 2 – Apply only during late evenings or early morning[1]	
Decis	deltamethrin
Endosulfan, Thiodan, Thionex	endosulfan

[1] Unusually low temperatures at time of application may cause insecticides to remain toxic up to 20 times longer than during warm weather. High temperatures in the early morning or late evening may extend active foraging by bees.

Disposal of Pesticides and Empty Pesticide Containers

Triple or Jet Rinse Your Empty Pesticide Containers

Unrinsed pesticide containers are not really empty. They may still hold about 1% of the original amount of pesticide. Although this figure sounds low, it is still a hazard to humans, animals and the environment. To reduce the hazard, rinse each container three times as the spray tank is filling. Use either the manual triple-rinse technique, or a specially designed device for rinsing containers. Paper or cardboard containers are often strong enough to be rinsed. If it is possible, rinse these containers as well as plastic ones.

To Triple Rinse

1. Fill the empty container at least 10% full with the diluting material (usually water).
2. Cap, then shake or roll the container so that the inside surfaces of the container are well rinsed.
3. Pour rinsings into the spray tank.
4. Repeat steps 1–3 twice more.

Remember to check the container after you have finished rinsing. Make sure no pesticide has been left behind as a cake or paste on the bottom of the container.

Rinsing Devices

Rinsing devices use pressurized water to clean the container. They are just as effective as triple rinsing but take less time. Follow the manufacturer's instructions.

How to Dispose of Empty, Triple-Rinsed Containers

Never re-use empty pesticide containers. They may be handy, but there is still some risk, even if the containers are triple rinsed. Never give empty, rinsed containers to anyone, especially children. Dispose of them promptly.

Regulation 914 of the *Pesticides Act* regulates how pesticide containers are to be disposed of in Ontario. [Reg. 914, s. 27]

For Metal, Plastic or Glass Containers

Dispose of an empty metal, plastic or glass container that has been used to hold a Schedule 1, 2, 3*, 5 or 6* (*non-domestic) pesticide by:

- triple rinsing or jet rinsing using clean water, or another appropriate solvent

AND either

- taking it for recycling to a pesticide container depot

OR

- taking it to a licensed waste disposal site.

Once containers are properly rinsed, they should be punctured to make it impossible to use them again and to make sure the rinse water is totally out of the container.

It is often more convenient to store empty, rinsed containers until you have collected enough to make a trip to the recycling Pesticide Container Depot or the waste disposal site. If you store containers, keep them in a dry safe place, such as the storage area, until you can dispose of them properly.

Recycling

The Ontario Pesticide Container Recycling Program is available to growers and commercial applicators (exterminators). Through this program, clean, triple-rinsed, plastic/metal pesticide containers (up to 23 L in size for plastic and 20 L in size for metal) can be returned to pesticide container depots located throughout the province.

> To locate the Pesticide Container Recycling Depot closest to you, call the Ontario Pesticide Education Program at 1-800-652-8573.

For Paper and Cardboard Containers

A paper or cardboard container that has been used to hold a Schedule 1, 2, 3*, 5 or 6* (*non-domestic) pesticide shall be disposed by:

- triple-rinsing or jet rinsing (if possible) using clean water

AND either

- burning (if allowed by municipal by-laws) in circumstances that persons and animals are kept out of any smoke produced and any smoke is directed away from buildings, highways, roads or outdoor areas frequented by the public

OR

- taking it to a licensed waste disposal site.

Paper or cardboard containers are often rigid enough to withstand rinsing. If possible, triple-rinse these containers as you fill the tank. Then burn the containers in an isolated area on your farmland.

Be very careful around the smoke. It may contain toxic fumes from the burning pesticide. Be certain there is no chance that a person or animal may breathe in this smoke. Make sure the smoke does not drift toward buildings, roads or any public outdoor areas.

These containers can also be taken to a local waste disposal site in the same way as metal, plastic or glass containers. If you can't dispose of them immediately, make sure containers are kept in a secure place such as the pesticide storage area.

Unwanted Pesticides

If you have pesticides you do not need or cannot use, be sure to dispose of them safely.

- Contact the supplier. It is sometimes possible to return unused pesticide if it is still in its original container.
- If you cannot find any way to use the product as shown on the label, then the Ministry of the Environment requires that waste be disposed of by licensed waste haulers to a licensed waste disposal site. Look in the Yellow Pages of your telephone directory under "Liquid Waste Removal."
- Watch your local paper for Municipal Waste Collection Days or contact your municipality. If your municipality has no waste collection days, encourage them to sponsor such an event. On these days, you can turn over surplus pesticide concentrates (maximum 25 L) for disposal.

Surplus Spray Mix

The best way to dispose of any excess spray mix is to find other fields that require an application of this pesticide.

Before spraying, check the label to make sure the pesticide is registered for use on that crop.

If you can't find another field to spray, dilute the remaining spray mix by adding 10 parts of water for each 1 part of spray mix. This diluted solution can be safely applied to the treated area as long as you do not exceed the pesticide rate recommended on the label. Be sure to check the label for any restrictions about crop rotation, days to harvest or surplus spray mix disposal.

NEVER re-spray the treated field with undiluted spray mix. Spraying an area twice will double the recommended pesticide rate. This may cause illegal pesticide residues in the harvested crop or harmful residues in the soil that can cause crop damage.

Soluble Packaging Options

Choose soluble packages that dissolve in the spray tank to reduce container disposal. Water-soluble packaging is used for dry flowable and wettable powder formulations of pesticides and is available under names such as Clean Pak, Solupak and Toss-N-Go. In most cases, the water-soluble packaging material is PVA (poly-vinyl alcohol). This material dissolves completely when added to the water in the sprayer tank according to instructions.

Read all labels and instructions carefully. For more details contact your vendor.

Keep soluble pouches dry until you add them to the spray tank:

- Do not handle pouches with wet hands or wet gloves.
- Do not remove pouches from the outer package until you are ready to add them.
- Always reseal the outer package to protect the remaining pouches from moisture.

Mixing Soluble Pouches

- Consult product labels for specific mixing instructions for each product.
- Fill the spray tank half full of water. With the agitator running, add the water-soluble pouches to the tank.
- Most pouches dissolve completely within 5 minutes, depending on the water temperature and the degree of agitation.
- As the tank continues to fill, add any other compatible pesticides.

Do not add:

- a pesticide that is incompatible with the PVA packaging material. The PVA material is not soluble with summer-type oils (e.g., Superior Oil).
- any material containing boron (e.g., Solubor), chelated micronutrients or water-soluble fertilizers. This combination is likely to cause a sticky, insoluble substance in the tank. If you apply boron, chelated micronutrients or water-soluble fertilizers, make sure that you completely empty and rinse the spray tank before you use any product packaged in PVA.

Pesticide Spills

If a pesticide spill causes, or is likely to cause, an adverse effect, you must notify the Ministry of Environment Spills Action Centre at 1-800-268-6060 (24 hr a day, 7 days a week) and the municipality.

Protect yourself before you begin to clean up any spill. Clean up spills immediately.

In the case of minor spills:

- for liquids, cover the spill with a thick layer of absorbent material such as kitty litter, vermiculite or dry soil. Sweep or shovel the material into a waste drum.
- for powders and granulars, sweep or shovel the material into a waste drum.

In the case of a major spill:

- remove any people or animals from the spill area
- stop the spill from spreading
- do not let the pesticide enter any watercourse.

For information on preventing spills, see the OMAFRA Factsheet, *Ways to Avoid Pesticide Spills*, Order No. 96-025.

Storing Pesticides

Ontario's *Pesticides Act* and Regulation 914 give storage requirements for storage facilities. The storage requirements you must follow depend on which schedules of pesticides you store. See Table 1–6, *Pesticides Act Storage Requirements*, below, and the OMAFRA Factsheet, *Pesticide Handling Facilities*, Order No. 94-037.

Table 1–6.
Pesticides Act Storage Requirements

	Schedule		
	3, 4, 6	2	1, 5
No contact with food or drink	•	•	•
Not impair health/safety	•	•	•
Clean & orderly manner	•	•	•
Warning signs posted on storage buildings	•	•	•
Warning signs posted on unattended vehicles	•	•	•
Emergency telephone numbers posted	•	•	•
Ventilated to outside		•	•
Limited access (locked)		•	•
No floor drain		•	•
Safety equipment available		•	•
Area used exclusively for pesticides			•

Application Procedures

Sprayers

- Sprayers that can deliver enough litres per hectare for adequate coverage are satisfactory for applying emulsion-type insecticides.
- If 2,4-D or related herbicides are used, clean the sprayers thoroughly with detergent containing ammonia to prevent crop damage.
- Adequate agitation is essential when applying wettable powder formulations.
- Pumps should be capable of delivering the flow and pressure required as well as being compatible with materials sprayed.
- Keep in mind that the higher the pressure, the greater the danger of drift to other crops.
- Calibrate your sprayer at least twice during the growing season with each set of nozzles used. The wear on nozzles and other parts will alter the amount of spray delivered.
- Check all nozzles for flow rate at least once a year. If any nozzle is more than 5% above or below the average output, it should be cleaned or replaced.
- For information on calibration, see the current OMAFRA Publication 75, *Guide to Weed Control*. See calibration calculator on the OMAFRA website at www.ontario.ca/crops.

Fumigants (Gases, Vapours and Fumes/ Smokes)

Read and follow all instructions on the product label regarding protective clothing and equipment, aeration of treated areas and re-entry periods. When fumigating a greenhouse, lock the building and post warning signs. As a safety precaution, have someone else who is wearing personal protective equipment help with the fumigation. This is a requirement for all fumigant gas use.

If you use a fumigant gas such as methyl bromide plus chloropicrin or aluminum phosphide to fumigate a structure, you must hold the appropriate licence and obtain a permit issued under Ontario's *Pesticides Act*. To apply for a permit, contact the regional pesticides officer with the Ontario Ministry of the Environment (see Appendix D, *Ontario Ministry of the Environment Pesticide Control Offices*, on page 82, for contact information).

When you handle methyl bromide, *do not* wear gloves. Wear a self-contained positive-pressure breathing apparatus. When you handle aluminum phosphide, use cotton gloves and wear a full-face mask respirator with an acid gas canister, or a self-contained positive-pressure breathing apparatus.

> For more information, see the Fumigation Study Module from Ontario Pesticide Training and Certification, compiled by the Ontario Ministry of the Environment.

Band Spraying

When banding pesticides, apply the recommended rate over the strip of row you wish to treat. Banding does not result in a more concentrated spray mixture. It does allow you to cover more area with the same amount used in a broadcast application. Check the product label under "Directions for Use." Some labels give specific nozzle recommendations and formulas to determine band application rates.

To know how much to mix, you will first need to calculate the size of the entire treated area. To calculate the total area of all the treated bands:

$$\text{Treated Area of Bands (ha or ac)} = \text{Total Area of Planted Field (ha or ac)} \times \frac{\text{Band Width (cm or in)}}{\text{Row Spacing (cm or in)}}$$

Seed Treatments

Treated seed products are also pesticides. They are poisonous to people and animals.

Wear protective clothing and equipment when you are treating seed or handling treated seed. Protect your skin. Wear a long-sleeved shirt, long pants or coveralls and wear neoprene or nitrile gloves. Protect your eyes with goggles and/or a face shield. Wear a respirator to protect your lungs from dusts and vapours.

Wash thoroughly after finishing the treatment or handling the treated seed. Never feed treated seed to animals. Keep treated seed out of the reach of children.

Destroy all the bags that have held treated seed as recommended in the section *Disposal of Pesticides and Empty Pesticide Containers*, on page 10.

See Table 1–7, *Seed Treatments*, on page 14, for a list of seed treatments recommended in this publication.

Aerial Application by Airplane or Helicopter

Any person who applies pesticide from an aircraft in Ontario must hold an aerial exterminator licence. In addition, a permit is required to purchase and apply pesticides by air for the following:

- applications to surface water*, e.g., ponds, lakes, rivers; * A permit is required for all means of pesticide application to surface water.
- applications to forests as defined in the *Crown Forest Sustainability Act*
- applications of any Schedule 1 or 5 pesticide

Be sure that any pesticide you apply by air has specific instructions for aerial use on the label. Take extra precautions when using insecticides applied by air that are toxic to honeybees, such as Sevin (carbaryl) or Furadan (carbofuran).

See Table 1–8, *Fungicides*, on page 15, and Table 1–9, *Insecticides*, on page 16, for a list of the fungicides and insecticides recommended in this publication.

Table 1–7. Seed Treatments

TRADE NAME	Active Ingredient	Chemical Family	Risk of Resistance Developing[1]	Formulation	Crops	Manufacturer	Ontario Schedule[2]
Fungicides							
Anchor	carbathiin + thiram	anilide + dithiocarbamates	low	F (DB)	soybeans	Bayer CropScience	3
Allegiance FL	metalaxyl	acylamine	medium	F	soybeans, forages, corn, cereals, canola	Bayer CropScience	3
Apron FL	metalaxyl	acylamine	medium	F	soybeans, forages, corn, cereals, canola	Bayer CropScience	3
Apron XL LS	metalaxyl-M	acylamine	medium	LS	soybeans, corn, canola, wheat, forages, beans	Syngenta Crop Protection	2
Apron Maxx RTA	fludioxonil + metalaxyl-M	phenylpyrrole + acylamine	low to medium	F	soybeans, dry edible beans	Syngenta Crop Protection	2
Baytan 30	triadimenol	triazole	low to medium	F	wheat, barley	Bayer CropScience	3
Captan FL	captan	phthalimide	low	F	beans, corn, soybeans	Norac Concepts Inc.	2
Dividend XL RTA	difenoconazole + metalaxyl-M	triazole + acylamine	low to medium	F	wheat	Syngenta Crop Protection	2
Dynasty 100 FS	azoxystrobin	strobilurin	low		corn	Syngenta Crop Protection	2
Gemini	triticonazole + thiram	triazole + dithiocarbamate	low to medium	F	wheat, barley, oats	BASF Canada	2
Maxim 480 FS	fludioxonil	phenylpyrrole	low	F	corn, soybeans	Syngenta Crop Protection	2
Raxil T	tebuconazole	triazole	low to medium	F	wheat, barley, oats	Bayer CropScience	2
Thiram 75 WP	thiram	dithiocarbamates and relatives	low	P	alfalfa	Bayer CropScience	2
Vitaflo 280	carbathiin + thiram	anilide + dithiocarbamates	low	F	barley, wheat, oats, flax, dry edible beans, soybeans, rye, corn	Bayer CropScience	3
Vitavax RS Fungicide	carbathiin + thiram	anilide + dithiocarbamates	low	F	canola, mustard, rapeseed	Bayer CropScience	2
Insecticides							
Cruiser 5 FS	thiamethoxam	chloronicotine	medium to high	F	corn, soybeans	Syngenta Crop Protection	2
Cruiser 350 FS	thiamethoxam	chloronicotine	medium to high	F	wheat, barley, beans	Syngenta Crop Protection	2
Gaucho 480 FL	imidacloprid	chloronicotine	medium to high	F	canola, mustard, seed corn only	Bayer CropScience	5
Poncho 600 FS	clothianidin	chloronicotine	medium to high	F	canola, corn	Bayer CropScience	5
Fungicides With Insecticides							
Agrox B-2	diazinon + captan	organophosphate + phthalimide	low	P (DB)	corn, beans, soybeans	Norac Concepts Inc.	2
Agrox CD	diazinon + captan	organophosphate + phthalimide	low	P (DB)	corn, beans, soybeans	Norac Concepts Inc.	2
DCT	diazinon + captan + thiophanate-methyl	organophosphate + phthalimide + benzimidazole	low	P (DB)	dry edible beans	Norac Concepts Inc.	3
Gaucho CS	imidacloprid + carbathiin + thiram	chloronicotine + anilide + dithiocarbamates	low to medium	F	canola, mustard, rapeseed	Bayer CropScience	5
Helix Xtra	thiamethoxam + difenoconazole + metalaxyl-M + fludioxonil	chloronicotine+ triazole + acylamine + phenylpyrrole	low to medium	F	canola, mustard	Syngenta Crop Protection	2
Prosper	clothianidin + carbathiin + thiram+ metalaxyl	chloronicotine + anilide + dithiocarbamates + acylamine	low to medium	F	canola, rapeseed	Bayer CropScience	5

DB = Drill Box Application EC = Emulsifiable Concentrate F = Flowable LS = Liquid Suspension P = Powder

[1] Risk of resistance based on continuous use of product.

[2] The numbers identify the Schedules in which the TRADE NAME products listed are classified under the *Pesticide Act*. See Appendix C, *Ontario Classification Schedules*, on page 82, for an explanation of schedules.

Table 1–8. Fungicides

TRADE NAME	Active Ingredient	Fungicide Classification	Days to Harvest	Relative Toxicities	Aerial Application	Manufacturer	Use and Remarks	Ontario Sch.[1]
Botran 75 W	dichloran	nitroaniline	2	low	yes	Gowan Company	field beans	3
Bumper 418 EC	propiconazole	triazole	corn: 14 cereals: 45 canola: 60 beans: 28	low	yes for all crops listed	UAP Canada Inc.	wheat, oats, barley, corn, canola, dry edible beans, soybeans (for seed only)	2
Dithane DG Rainshield	mancozeb	dithiocarbamate	wheat: 40	low	yes for all crops listed	Dow AgroSciences	spring and winter wheat, alfalfa (for seed only)	3
Folicur 432 F	tebuconazole	triazole	wheat: 36	low	yes for all crops listed	Bayer CropScience	wheat, soybeans	2
Headline EC	pyraclostrobin	strobilurin	corn: 7 soybeans: 21 beans: 7 cereals: Do not apply after the boot stage (Zadok's 47 and beyond.)	low	yes for all crops listed except corn	BASF Canada	corn, soybeans, wheat, barley, rye, dry edible beans	2
Lance WDG	boscalid	carboxamide	21	low	yes for all crops listed	BASF Canada	canola, dry edible beans	5
Quadris	azoxystrobin	strobilurin	canola: 30 soybeans: 15 seed corn: 7 beans: 15	low	yes for all crops listed except seed corn	Syngenta Crop Protection	canola, seed corn, dry edible beans, soybeans	2
Quilt	azoxystrobin + propiconazole	strobilurin + triazole	soybeans: 30 beans: 30	low	yes for all crops listed	Syngenta Crop Protection	beans, soybeans	2
Ronilan EG	vinclozolin	dicarboximide	beans: 45 canola: 40	low	yes for all crops listed except beans	BASF Canada	dry edible beans, canola	3
Rovral WP	iprodione	dicarboximide	14	low	yes for all crops listed	Bayer CropScience	dry edible beans, canola	3
Senator 70 WP	thiophanate-methyl	benzimidazole	14	low	yes for all crops listed	Engage Agro	white beans	3
Stratego 250 EC	trifloxystrobin + propiconazole	strobilurin + triazole	45	low	yes for all crops listed	Bayer CropScience	wheat, barley, oats	2
Tilt 250 E	propiconazole	triazole	corn: 14 soybeans: 30 cereals: 45 canola: 60 beans: 28	low	yes for all crops listed	Syngenta Crop Protection	wheat, oats, barley, corn, canola, dry edible beans, soybeans	2

E = Emulsifiable Concentrate **EG = Extruded Granular** **F = Flowable** **WP = Wettable Powder**

[1] The numbers identify the Schedules in which the TRADE NAME products listed in this table are classified, under the *Pesticide Act*. See Appendix C, *Ontario Classification Schedules*, on page 82, for an explanation of schedules.

Table 1–9. Insecticides

TRADE NAME	Active ingredient	Insecticide Classification	Days to Harvest	Relative Toxicities	Aerial Application	Manufacturer	Use and Remarks	Ontario Sch.[1]
Cygon 480 EC	dimethoate	organophosphorus	alfalfa: 2 beans: 7 soybeans: 30 canola: 21 forages: 2	moderate	yes to all crops listed	Cheminova Canada	alfalfa, field beans, soybeans, canola, forages. Toxic to bees.	2
Decis 5.0 EC	deltamethrin	pyrethroid	canola: 14 corn: 5	moderate	yes to all crops listed except corn	Bayer CropScience	canola, corn, mustard, wheat, barley, oats Toxic to bees.	2
Dipel 2X DF	*Bacillus thuringiensis*	bacterial toxin	0	low	yes	Valent BioSciences	timothy, corn	3
Force 3 G	tefluthrin	pyrethroid	Planting time only	moderate	no	Syngenta Crop Protection	corn	2
Furadan 480 F	carbofuran	carbamate	canola: 60	high	yes to all crops listed	Bayer CropScience	canola, mustard Toxic to bees.	5
Imidan 50 WP	phosmet	organophosphorus	7	moderate	no	Gowan Company	alfalfa Toxic to bees.	3
Lagon 480 EC	dimethoate	organophosphorus	alfalfa: 2 beans: 7 soybeans: 30 canola: 21 cereal: 2	moderate	yes to all crops listed	United Agri Products	soybeans, beans, canola, alfalfa, cereals Toxic to bees.	2
Lannate Toss-N-Go 90 SP	methomyl	carbamate	cereals: 20 canola: 8	high	yes to all crops listed	Dupont Canada	cereals, canola Toxic to bees.	2
Lorsban 4 E, 15 G	chlorpyrifos	organophosphorus	corn: 70 canola: 21 wheat: 60	moderate	yes to all crops listed except corn	Dow AgroSciences	corn, cereals, canola Toxic to bees	2, 3
Malathion 500 EC	malathion	organophosphorus	alfalfa, 7 cereals: 7 corn: 7 beans: 3	low	no	United Agri Products	alfalfa, cereals, field beans, soybeans, corn. Toxic to bees. Less effective below 20°C.	3
Matador 120 EC	cyhalothrin-lambda	pyrethroid	corn: 14 canola: 7 wheat: 28 beans: 14 soybeans: 21	moderate	yes for all crops listed except soybeans and beans	Syngenta Crop Protection	corn, canola, alfalfa, wheat, barley, oats, soybeans, beans	5
Pounce EC	permethrin	pyrethroid	canola: 1	moderate	no	FMC Corp.	canola, cereals, corn, flax, sunflowers	3
Pyrifos 15G	chlorpyrifos	organophosphorus	Planting time only	moderate	no	United Agri Products	corn	5
Pyrinex 480 EC	chlorpyrifos	organophosphorus	corn: 7 0 cereals: 60 canola: 21	moderate	yes to all crops listed except corn	United Agri Products	corn, canola, cereals Toxic to bees.	2

E = Emulsifiable Concentrate EG = Extruded Granular F = Flowable WP = Wettable Powder

Table 1–9. Insecticides (continued)

TRADE NAME	Active ingredient	Insecticide Classification	Days to Harvest	Relative Toxicities	Aerial Application	Manufacturer	Use and Remarks	Ontario Sch.[1]
Ripcord 400 EC	cypermethrin	pyrethroid	canola: 30 wheat: 30 barley: 45 corn: 5	moderate	yes to all crops listed except wheat, barley and canola	BASF Canada	canola, corn, wheat Toxic to bees.	2
Sevin XLR Plus	carbaryl	carbamate	beans: 5 alfalfa: 2 oats: 14 wheat: 14 barley: 28 corn: 1	moderate	yes to all crops listed except beans and canola	Bayer CropScience	alfalfa, cereals, beans, corn, canola Toxic to bees.	3
Thimet 15 G	phorate	organophosphorus	Planting time only	high	no	BASF Canada	corn	2
Thiodan 4 EC	endosulfan	organo-chlorine	beans: 2 corn: 50 alfalfa, rye: 30	moderate	no	Bayer CropScience	field beans, corn, alfalfa, rye Toxic to bees.	2
Thionex EC	endosulfan	organo-chlorine	beans: 2 corn: 50 alfalfa: 30 rye: 30	moderate	no	United Agri Products	field beans, corn, alfalfa, rye. Toxic to bees	2
Thuricide HPC	*Bacillus thuringiensis*	bacterial toxin	0	low	yes	Thermo Trilogy	timothy	3

E = Emulsifiable Concentrate EG = Extruded Granular F = Flowable WP = Wettable Powder

[1] The numbers identify the Schedules in which the TRADE NAME products listed in this table are classified under the *Pesticide Act*. See Appendix C, *Ontario Classification Schedules*, on page 82, for an explanation of schedules.

Table 1–10. Transgenic Crops Expressing Insecticidal or Fungicidal Traits

TRADE NAME	Event	Cry Protein (delta endotoxin)	Bt strain	Manufacturer	Pests Controlled	Remarks[1]
Insecticides						
Corn						
Herculex I	TC1507	Cry 1F	*Bacillus thuringiensis* var. *aizawai*	Dow AgroSciences/ Pioneer Hi-Bred International	European corn borer (ECB) black cutworm* fall armyworm	* May only provide control of young larvae.
Herculex RW	DAS-59122-7	Cry 34Ab1 and Cry 35Ab1	*Bacillus thuringiensis* strain PS149B1	Dow AgroSciences/ Pioneer Hi-Bred International	corn rootworm larvae	
Herculex Xtra	TC1507 and DAS-59122-7	Cry 1F and Cry 34Ab1/Cry 35Ab1	*Bacillus thuringiensis* var. *aizawai* and *Bacillus thuringiensis* strain PS149B1	Dow AgroSciences/ Pioneer Hi-Bred International	European corn borer (ECB) black cutworm* fall armyworm corn rootworm larvae	* May only provide control of young larvae.
KnockOut	Event 176	Cry 1Ab	*Bacillus thuringiensis* var. *kurstaki*	Syngenta Seeds Canada	European corn borer	May not provide complete protection against 2nd generation ECB. Does not protect against ECB damage to the ear.
NatureGard	Event 176	Cry 1Ab	*Bacillus thuringiensis* var. *kurstaki*	Dow AgroSciences/ Mycogen Seeds	European corn borer	May not provide complete protection against 2nd generation ECB. Does not protect against ECB damage to the ear.
YieldGard	MON810	Cry 1Ab	*Bacillus thuringiensis* var. *kurstaki*	Monsanto Canada Inc.	European corn borer	
YieldGard	BT11	Cry 1Ab	*Bacillus thuringiensis* var. *kurstaki*	Syngenta Seeds Canada	European corn borer	
YieldGard Rootworm	MON863	Cry 3Bb1	*Bacillus thuringiensis* var. *SanDiego* (tenebrionis)	Monsanto Canada Inc.	corn rootworm larvae	
YieldGard Plus	MON810 and MON863	Cry 1Ab and Cry 3Bb1	*Bacillus thuringiensis* var. *kurstaki* and *Bacillus thuringiensis* var. *SanDiego* (tenebrionis)	Monsanto Canada Inc.	European corn borer corn rootworm larvae	

[1] Insect resistance management strategies must be followed when planting Bt corn. Refer to *A Grower's Handbook: Controlling Corn Insect Pests With Bt Corn Technology*, found at www.cornpest.ca for more information.

2. Corn (Field and Seed)

INSECTS

Table 2–1. Corn (Field and Seed) Seed and Soil-Applied Insecticide Recommendations

Active Ingredients	Trade Name	Formulation	Corn Insects				
			Corn Rootworm	European Chafer	Wireworms	Seedcorn Maggot	Black Cutworm
Seed Treatments							
Untreated Seed							
clothianidin	Poncho 600 at 0.25 mg ai per kernel (aka Poncho 250)	F	—	+	+	+	+
clothianidin	Poncho 600 at 1.25 mg ai per kernel (aka Poncho 1250)	F	+	+	+	+	+
diazinon + captan	Agrox B-2	P (DB)	—	—	—	+	—
imidacloprid	Gaucho 480 FL	F	—	—	+	—	—
thiamethoxam	Cruiser 5FS	F	—	+	+	+	—
Seed Pretreated With Fungicide							
diazinon + captan	Agrox CD	P (DB)	—		—	+	—
Soil-Applied Treatments							
chlorpyrifos	Lorsban 15 G	G	+		—	—	—
chlorpyrifos	Pyrifos 15 G	G	+		—	—	—
phorate	Thimet 15 G	G	+		—	—	—
tefluthrin	Force 3.0 G	G	+		+	+	S

DB = Drill Box Application F = Flowable G = Granular P = Powder

+ = recommended for insect listed — = NOT recommended S = suppression

Table 2–2. Chemical Control Options for Insects in Field and Seed Corn

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (Days to harvest, label precautions, etc.)
CORN ROOTWORM (*Diabrotica virgifera* and *Diabrotica barberi*)				
Soil-Applied at Planting Only			**per 100 m (328 ft) row**	
Avoid planting corn on corn. Crop rotation is the best strategy for control. Risk factors include heavier soil (clay), high beetle populations in corn of previous season, being the latest field planted in the previous season.	tefluthrin	Force 3 G	37.5 g	May be applied in a T-band or in-furrow. For banded applications, place directly over the furrow in a 15-cm band ahead of the press wheel. For in-furrow application, place all material directly in the open seed furrow, behind the planter disc openers.
If there is less than 1 beetle per corn plant on average throughout the month of August, then no insecticide is necessary in the following corn crop.	chlorpyrifos	Lorsban 15 G	75 g	Must be applied in a 10–15-cm band over the row behind the planter shoe, in front of the press wheel. Do not place in direct contact with seed.
		Pyrifos 15 G	75 g	
In-furrow application is safer to the applicator and non-target animals than T-band application.	phorate	Thimet 15 G	75 g	Lock and load. Must be applied in a 10–15-cm band over the row behind the planter shoe, in front of the press wheel. Do not place in direct contact with seed.
Seed Treatment			**per 80,000 kernels**	
Seed treatments are best suited for those fields at high risk, especially corn after corn.	clothianidin	Poncho 1250	166.6 mL	**For use in commercial seed treaters only.** Seed-applied insecticides can affect seed drop and final plant stands. Use talc or graphite according to planter recommendations to ensure accuracy.
Transgenic				
To manage potential rootworm resistance, plant a minimum of 20% of total corn acreage to non-Bt corn hybrids and position the refuge within or directly adjacent to the YieldGard Rootworm Bt corn field. Refuge can be treated for rootworm larvae with soil-applied insecticides if thresholds prescribe it. Insecticide use for adult control is not permitted. For more information regarding Bt corn and/or refuge options, see *A Grower's Handbook: Controlling Corn Insect Pests With Bt Corn Technology* found at www.cornpest.ca.		Herculex RW Herculex Xtra YieldGard RW YieldGard Plus	See Table 1–10, *Transgenic Crops Expressing Insecticidal or Fungicidal Traits*, on page 18, for Bt corn options	Keep careful and accurate records as to where Bt and non-Bt hybrids are planted.
WIREWORMS (*Limonius* spp. and others)				
Seed Treatment			**per 80,000 kernels**	
Risk factors include history of cereal/corn/grassy weeds, sandy soils, history of wireworm problems, coming out of sod.	clothianidin	Poncho 250	33.3 mL	**For use in commercial seed treaters only.** Seed-applied insecticides can affect seed drop and final plant stands. Use talc or graphite according to planter recommendations to ensure accuracy.
Threshold is one wireworm per bait trap. For bait trap information, see OMAFRA Publication 811, *Agronomy Guide for Field Crops*.	imidacloprid	Gaucho 480 FL	27 mL	**For use in commercial seed treaters only.** Seed-applied insecticides can affect seed drop and final plant stands. Use talc or graphite according to planter recommendations to ensure accuracy.
	thiamethoxam	Cruiser 5 FS	16.7 mL	**For use in commercial seed treaters only.** Do not graze or feed livestock on treated areas for 45 days after planting.
Soil Applied at Planting Only			**per 100-m (328-ft) row**	
In-furrow application is safer to the applicator and non-target animals than T-band application.	tefluthrin	Force 3 G	37.5 g	In-furrow only. Place directly in the seed furrow behind the planter disc openers.

Table 2–2. Chemical Control Options for Insects in Field and Seed Corn (continued)

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (Days to harvest, label precautions, etc.)
MILLIPEDES (Various species)				
Can be a pest in cool, wet springs in fields with heavy residue or high organic matter. Can be misidentified as wireworms. Ensure proper identification has been made.				No registered products available at this time.
SEEDCORN MAGGOT *(Delia platura)*				
Seed Treatment			**per 100 kg seed**	
Seedcorn maggot problems in corn are extremely rare in Ontario. Use seed treatments in high-risk fields where large amounts of manure, green manure or residue have been recently incorporated, in fields that are freshly tilled or when cool, backward emergence conditions exist.	**For all seed treatments use full rate and ensure good coverage of seed.**			
	diazinon + captan	Agrox B-2	340 g	Available as 2-kg container that will treat 600 kg of corn seed. Do not use on seed already treated with an insecticide. Seed within 1 month of treatment.
		Agrox CD	200 g	Available as a 600-g container that will treat 300 kg of corn seed. Use this product only on seed previously treated with captan or thiram.
			per 80,000 kernels	
	clothianidin	Poncho 250	33.3 mL	**For use in commercial seed treaters only.** Seed-applied insecticides can affect seed drop and final plant stands. Use talc or graphite according to planter recommendations to ensure accuracy.
	thiamethoxam	Cruiser 5 FS	16.7–33.3 mL	**For use in commercial seed treaters only.** Use the higher rate for fields that have a history of moderate-to-severe pest pressure. Do not graze or feed livestock on treated areas for 45 days after planting.
Soil-Applied at Planting Only			**per 100-m (328-ft) row**	
In-furrow application is safer to the applicator and non-target animals than T-band application.	tefluthrin	Force 3 G	37.5 g	In-furrow only. Place directly in the seed furrow behind the planter disc openers.
SEEDCORN BEETLE *(Agonoderus lecontei* and *Clivina impressifrons)*				
Risk factors: no-till, cool, backwards spring, slow emergence conditions.				No registered products available at this time.

Table 2–2. Chemical Control Options for Insects in Field and Seed Corn (continued)

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (Days to harvest, label precautions, etc.)
BLACK CUTWORM *(Agrotis ipsilon)*				
Soil-Applied at Planting Only			**per 100-m (328-ft) row**	
Risk factors: winter annual weeds and volunteer wheat before planting, no-till, heavy soybean residue. Control annual weeds at least 3 weeks prior to planting to reduce attraction by adult moths flying in from the US.	tefluthrin	Force 3 G	37.5 g	Soil-applied control is not as good as a well-timed rescue treatment. May be applied as a banded or in-furrow application. For banded applications, place directly in a 15-cm band ahead of the press wheel. For in-furrow application, place all material directly in the open seed furrow, behind the planter disc openers.
Seed Treatment			**per 80,000 kernels**	
Cutworm is a sporadic pest. Using seed treatments specifically for black cutworm control is not recommended unless the field has had a continous history of cutworm injury.	clothianidin	Poncho 250	33.3 mL	**For use in commercial seed treaters only.** Seed-applied insecticides can affect seed drop and final plant stands. Use talc or graphite according to planter recommendations to ensure accuracy.
Transgenic Corn				
		Herculex I Herculex Xtra	See Table 1–10, *Transgenic Crops Expressing Insecticidal or Fungicidal Traits*, on page 18, for Bt corn options	Herculex varieties only. May only control young larvae.
Rescue Treatments			**per ha (per ac)**	
Scout early! Cutworms are easier to control when small. Look for leaf -feeding (pinholes) by young climbing larvae as first sign of damage. If more than 10% of plants show leaf feeding, treating at this time will give nearly 100% control.	permethrin	Pounce EC	175–390 mL (70–156 mL)	Seedling stage only. Apply under warm, moist conditions in evening or night when cutworms are most active. Do not disturb soil for 5 days after application.
	cypermethrin	Ripcord 400 EC	175 mL (70 mL)	Seedling stage only. Apply under warm, moist conditions in evening or night when cutworms are most active. Do not disturb soil for 5 days after application. 21 days to harvest.
	chlorpyrifos	Lorsban 4E	1.2–2.4 L (480–960 mL)	Seedling stage only. 70 days to harvest.
		Pyrinex 480 EC	1.2–2.4 L (480–960 mL)	Seedling stage only. Apply once per season. 70 days to harvest.
	cyhalothrin-lambda	Matador 120 EC	83 mL (34 mL)	Seedling stage only. Ground or aerial application. Apply under warm, moist conditions in evening or night when cutworms are most active. Do not disturb soil for 5 days after application. 3 applications/season, 2 may be by air. 14 days to harvest.
EUROPEAN CHAFER *(Rhizotrogus majalis)*				
Seed Treatment			**per 80,000 kernels**	
Avoid planting corn if grub population is extreme — plant soybeans instead. 2 or more larvae per square foot indicates the need for control. If grub populations are high (i.e., 6 or more grubs per square foot) using the higher rate of seed treatment is recommended. See OMAFRA Publication 811, *Agronomy Guide for Field Crops*, for further information on insect biology and management options.	clothianidin	Poncho 250	33.3 mL	**For use in commercial seed treaters only.** Seed-applied insecticides can affect seed drop and final plant stands. Use talc or graphite according to planter recommendations to ensure accuracy.
	thiamethoxam	Cruiser 5 FS	16.7 mL	**For use in commercial seed treaters only.** Do not graze or feed livestock on treated areas for 45 days after planting.

Table 2–2. Chemical Control Options for Insects in Field and Seed Corn (continued)

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (Days to harvest, label precautions, etc.)
EUROPEAN CORN BORER (ECB) *(Ostrinia nubilalis)*				
To manage potential corn borer resistance, plant a minimum of 20% of total acreage to non-Bt corn refuge and position it so that the refuge is no more than 400 m from the Bt corn planting. Do not apply ECB insecticide to non-Bt refuge. For more information regarding Bt corn and/or refuge options, see *A Grower's Handbook: Controlling Corn Insect Pests With Bt Corn Technology* found at www.cornpest.ca.		Transgenic Bt corn hybrids	See Table 1–10, *Transgenic Crops Expressing Insecticidal or Fungicidal Traits*, on page 18, for Bt corn options	Insecticides have generally not provided economic control of ECB in field corn. Using Bt transgenic corn provides much better control. Use corn hybrids that express the Bt toxin in the ear as well as the stalk to help avoid stalk and ear rot. Keep careful and accurate records as to where Bt and non-Bt hybrids are planted.
Seed corn only			**per ha (per ac)**	
See OMAFRA Publication 811, *Agronomy Guide for Field Crops*, to calculate economic thresholds.	deltamethrin	Decis 5.0 EC	250–300 mL (100–120 mL)	Ground or aerial application. Apply when egg masses begin to hatch but no later than when 1st pinhole feeding occurs on foliage. For 2nd brood in late planting, apply before tassels show. Repeat in 5–8-day intervals. Maximum 3 applications/yr. Do not feed silage or stubble to dairy cattle.
	cypermethrin	Ripcord 400 EC	175 mL (70 mL)	Apply when egg masses begin to hatch but no later than when 1st feeding occurs on foliage. For 2nd brood in late planting, apply before tassels show. Use a minimum 300–500 L water/ha for ground application and 11–22 L/ha for aerial application. Re-entry period when foliage dries. Maximum 3 applications/yr. Up to 2 applications/season by air. 5 days to harvest.
	cyhalothrin-lambda	Matador 120 E	83 mL (34 mL)	Ground or aerial application. Spray no later than 1st appearance of feeding. Spray no later than 14 days before silage harvest. No more than 3 applications per season, 2 may be by air.
	Bacillus thuringiensis	Dipel 2X DF	0.56–1.12 kg (0.22 –0.45 kg)	Good option for organically grown corn. Apply when pinhole feeding is observed in at least 5% of the plants. Repeat at 7-day intervals. Only effective against small larvae and must be applied before larvae begin stalk boring.
	carbaryl	Sevin XLR Plus	2.5–4.0 L (1.0–1.6 L)	For larvae in whorls and foliage, treat entire plant. Repeat as necessary. For silks and ears, apply in 2–4-day intervals when silks first appear. 1 day to harvest. Follow label precautions applying to honeybees.
ARMYWORM (TRUE – *Pseudaletia unipuncta*, FALL – *Spodoptera frugiperda*)			**per ha (per ac)**	
Five to six larvae in an area 30 x 30 cm warrant chemical control. Treat if larvae <2.0 cm long and threshold has been exceeded. If larvae have white eggs attached to them, they are parasitized and may not need treatment. If larvae are 2.0 cm or larger, chemical control will not work well and is not recommended.	carbaryl	Sevin XLR Plus	2.5–4.0 L (1.0–1.6 L)	For larvae in whorls and foliage, treat entire plant. Repeat as necessary. For silks and ears, apply in 2–4-day intervals. 1 day to harvest. Follow label precautions regarding honeybees.
	cyhalothrin-lambda	Matador 120 E	83 mL (34 mL)	Ground or aerial application. Spray no later than 1st appearance of feeding. Spray no later than 14 days before silage harvest. No more than 3 applications per season, 2 may be by air.
CORN EARWORM (CEW) *(Helicoverpa zea)*			**per ha (per ac)**	
Insecticides have generally not provided economic control of CEW in field corn. There may be some value in treating seed corn to maintain kernel quality.	cyhalothrin-lambda	Matador 120 E	83 mL (34 mL)	Spray no later than 1st appearance of feeding. Spray no later than 14 days before silage harvest. No more than 3 applications per season, 2 may be by air.
	cypermethrin	Ripcord 400 EC	175 mL (70 mL)	Ground or aerial application. Ensure good coverage of ears and silks. Use minimum 300–500 L/ha of water for ground application and 11–22 L/ha for aerial application. 5 days to harvest. Maximum of 3 applications per year, 2 may be by air.

Table 2–2. Chemical Control Options for Insects in Field and Seed Corn (continued)

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (Days to harvest, label precautions, etc.)
CORN FLEA BEETLE *(Chaetocnema pulicaria)*				
Seed Treatment			**per 80,000 kernels**	
Flea beetles are a vector of Stewart's bacterial wilt. It is uneconomical to spray corn with insecticides to protect against Stewart's wilt except in seed corn with highly susceptible inbreds.	clothianidin	Poncho 250	33.3 mL	**For use in commercial seed treaters only.** Seed-applied insecticides can affect seed drop and final plant stands. Use talc or graphite according to planter recommendations to ensure accuracy.
	imidacloprid	Gaucho 480 FL	100 mL	**For seed corn only.** Ensure good coverage. For use in commercial seed treaters only. Seed-applied insecticides can affect seed drop and final plant stands. Use talc or graphite according to planter recommendations to ensure accuracy.
	thiamethoxam	Cruiser 5FS	16.7–33.3 mL	**For use in commercial seed treaters only.** Do not graze or feed livestock on treated areas for 45 days after planting.
POTATO STEM BORER *(Hydraecia micacea)*				
No insecticides are recommended or registered.				
SLUGS (Various species)				
Usually not an economic pest because growing point is not affected. Chemical control is not recommended.				
CORN LEAF APHID *(Rhopalosiphum maidis)*			**per ha (per ac)**	
Aphids are rarely a problem in corn in Ontario. Spray only if populations exceed 400 aphids per plant on average.	endosulfan	Thiodan 4 EC	2.75 L (1.1 L)	Ground application only. No more than 2 applications per season. 50 days to harvest.
		Thionex EC	2.75 L (1.1 L)	
SAP BEETLES *(Glischrochilus quadrisignatus)*				
Not an economic pest but can carry Fusarium. Chemical control is not recommended.				

Table 2–3. Corn (Field and Seed) Seed and Soil-Applied Fungicide Recommendations

Active Ingredients	Product	Formulation	Corn Diseases				
			Fusarium Seedling Blight	Rhizoctonia Damping-Off	Pythium Damping-Off	Aspergillus Seed Rot	Penicillium Seed Rot
Insect and Disease Control							
Untreated Seed							
diazinon + captan	Agrox B–2	P (DB)	+	—	—	+	+
Seed Pretreated With Fungicide							
diazinon + captan	Agrox CD	P (DB)	For insect control only. Disease control via fungicide pretreatment.				
Disease Control							
azoxystrobin	Dynasty 100 FS	F	—	+	+	—	—
captan	Captan Flowable	F	+	—	—	+	+
carbathiin + thiram	Vitaflo-280	F	+	+	—	—	—
fludioxonil	Maxim 480 FS	F	+	+	—	+	+
metalaxyl	Allegiance FL	F	—	—	+	—	—
metalaxyl	Apron FL	F	—	—	+	—	—
metalaxyl-M	Apron XL	LS	—	—	+	—	—

DB = Drill Box Application **F = Flowable** **LS = Liquid Suspension** **P= Powder**

+ = Recommended for disease listed **— = NOT recommended**

Table 2–4. Chemical Control Options for Diseases in Field and Seed Corn

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (Days to harvest, label precautions etc.)
It is recommended that all seed corn be treated with a fungicide seed treatment to prevent early-season preemergence and postemergent damping-off problems. This will help reduce seed decay and seedling blights. Corn seedling diseases are prevalent under cool wet conditions that keep the soil temperatures below 13°C (55°F). Low-lying or poorly drained areas of the field are often the first to show disease problems. Seed rots and seedling blights are more severe in no-till or reduced-tillage fields since heavy residue will keep soil temperatures cooler and wetter longer than conventional fields. Damping-off will occur in conventional fields when the crop is planted early into conditions that favour disease development or when environmental conditions cause the corn seed to sit in the ground for a prolonged period of time. Other factors that delay germination and emergence, such as compaction, crusting, deep planting, etc., can also result in a poor stand. Plant vigour is often reduced in those plants that do survive.				
DAMPING-OFF PYTHIUM *(Pythium* spp.*)*				
Seed Treatment			**per 100 kg seed**	
Can occur on all soil types but losses are greatest in cold, wet clay soils. Minimize soil compaction and remove excess moisture through increased drainage. Plant when soil temperatures are above 13°C (55°F). Treat seed with metalaxyl or metalaxyl-M. No known resistance but some degree of tolerance available in hybrids. Rotation has limited effect.	metalaxyl-M	Apron XL LS	20–40 mL	Do not use in hopper-box, planter-box, slurry-box or other non-commercial seed treatment applications at or immediately before planting. Do not graze or cut for forage within 4 weeks after planting. Read label for information regarding resistant strains of fungus.
	metalaxyl	Allegiance FL	46–110 mL	Do not graze or feed livestock on seeded area for 4 weeks after planting.
		Apron FL	46–110 mL	
	azoxystrobin	Dynasty 100 FS	10 mL	For use in commercial seed treatment plants only. Do not use in hopper-box, planter-box, slurry-box or other non-commercial seed treatment applications at or immediately before planting. Must be used in combination with Maxim XL.
RHIZOCTONIA *(Rhizoctonia solani)*				
Seed Treatment			**per 100 kg seed**	
Can occur on all soil types. No known resistance. Remove excess moisture. Plant when soil temperatures are above 13°C (55°F).	fludioxonil	Maxim 480 FS	5.2–10.4 mL	Do not use in hopper-box, planter-box, slurry-box or other non-commercial seed treatment applications at or immediately before planting. Do not graze or cut for forage within 4 weeks after planting. 30 days to harvest.
	carbathiin + thiram	Vitaflo 280	280 mL	Do not graze or feed livestock on treated areas for 4 weeks after planting.
	azoxystrobin	Dynasty 100 FS	10 mL	For use in commercial seed treatment plants only. Do not use in hopper-box, planter-box, slurry-box or other non-commercial seed treatment applications at or immediately before planting. Must be used in combination with Maxim XL.
FUSARIUM SEEDLING BLIGHT *(F. culmorum, F. graminearum* and *F. avenaceum)*				
Seed Treatment			**per 100 kg seed**	
Some level of resistance or tolerance available in hybrids. Rotate with other crops. Tillage has little affect. Treat seed with fungicide and reduce early-season stresses. Plant when soil temperatures are above 13°C (55°F).	fludioxonil	Maxim 480 FS	5.2–10.4 mL	Do not use in hopper-box, planter-box, slurry-box or other non-commercial seed treatment applications at or immediately before planting. Do not graze or cut for forage within 4 weeks after planting. 30 days to harvest.
	carbathiin + thiram	Vitaflo 280	280 mL	Do not graze or feed livestock on treated areas for 4 weeks after planting.
	captan	Captan Flowable	200 mL	Mix with the amount of water required for the slurry treater equipment to be used.

Table 2–4. Chemical Control Options for Diseases in Field and Seed Corn (continued)

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (Days to harvest, label precautions etc.)
ASPERGILLUS *(Aspergillus* spp.) and PENICILLIUM *(Penicillium oxalicum)* SEED ROT				
Seed Treatment			**per 100 kg seed**	
Penicillium seedling blight favours high temperatures and is found only until the nodal roots develop. Infected roots may appear blue-green. Aspergillus seed rot is not generally a problem in Ontario.	fludioxonil	Maxim 480 FS	5.2–10.4 mL	Do not use in hopper-box, planter-box, slurry-box or other non-commercial seed treatment applications at or immediately before planting. Do not graze or cut for forage within 4 weeks after planting. 30 days to harvest.
RUST *(Puccinia sorghi)*			**per ha (per ac)**	
Rust is generally not a problem in Ontario except when infection begins early in the season. Field corn has good resistance when compared to seed corn, sweet corn and specialty corn hybrids. As a result, foliar fungicides in field corn are not needed unless significant disease appears before corn tassels. Humid, cool conditions favour the disease.	propiconazole	Tilt 250 E	500 mL (200 mL)	Ground and aerial application. Apply when rust pustules first appear. Can be tank mixed with Ripcord or Matador insecticide for insect and disease control. Under severe disease pressure, a second application 14 days later may be necessary. **Only in seed corn, under severe disease pressure, a third application 14 days later can be made.** 14 days to harvest.
		Bumper 418 EC	300 mL (121 mL)	
	azoxystrobin	Quadris	453 mL (183 mL)	Ground application only. Apply prior to disease development. Second application may be made 7–14 days later. Maximum 2 applications per season. 7 days to harvest.
	pyraclostrobin	Headline EC	400–600 mL (160–240 mL)	Ground application only. Use a minimum water volume of 100 L/ha. For optimal disease control, begin applications prior to disease development. Do not graze treated crop within 6 days of last application. 7 days to harvest. Maximum of 2 applications/yr. 48 hrs re-entry period.
NORTHERN CORN LEAF BLIGHT *(Setospaeria turcica)*				
Incidence of this disease is on the rise in Ontario. Not generally a problem in field corn, since good resistance available. Seed corn may need protection. Crop rotation and tillage will reduce inoculum levels in surface residues. In reduced tillage systems, rotation and resistance are necessary. Chemical control not usually economical in field corn.	propiconazole	Tilt 250 E	250–500 mL (100–200 mL)	Ground and aerial application. Apply when disease first appears. Can be tank mixed with Ripcord or Matador insecticide for insect and disease control. 14 days to harvest.
		Bumper 418 EC	150–300 mL (60–121 mL)	
HELMINTHOSPORIUM LEAF SPOT *(Cochliobolus carbonum)*				
Not generally a problem in Ontario since resistance hybrids are available. Crop rotation and tillage will reduce inoculum levels in surface residues. In reduced tillage systems, rotation and resistance are necessary. Chemical control not usually economical in field corn.	propiconazole	Tilt 250 E	250–500 mL (100–200 mL)	Ground and aerial application. Apply when disease first appears. Can be tank mixed with Ripcord or Matador insecticide for insect and disease control. 14 days to harvest.
		Bumper 418 EC	150–300 mL (60–121 mL)	
EYE SPOT *(Aureobasidium zeae)*			**per ha (per ac)**	
Many resistant or tolerant commercial hybrids are available. Crop rotation and tillage will reduce inoculum levels in surface residues. In reduced tillage systems, rotation and resistance are necessary. Chemical control usually not economical in field corn but may be necessary if a very susceptible seed corn inbred is used.	propiconazole	Tilt 250 E	500 mL (200 mL)	Ground and aerial application. Apply when disease first appears. Can be tank mixed with Ripcord or Matador insecticide for insect and disease control. 14 days to harvest.
		Bumper 418 EC	300 mL (121 mL)	

Table 2–4. Chemical Control Options for Diseases in Field and Seed Corn (continued)

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (Days to harvest, label precautions etc.)
GREY LEAF SPOT *(Cercospora zeae-maydis)*			**per ha (per ac)**	
This disease is becoming more common in Southwestern Ontario. Some hybrids are tolerant/resistant to the disease. Crop rotation and tillage will reduce inoculum levels in surface residues. In reduced tillage systems, rotation and resistance are necessary. Chemical control usually not economical in field corn.	propiconazole	Tilt 250 E	500 mL (200 mL)	Ground and aerial application. Apply when disease first appears. Can be tank mixed with Ripcord or Matador insecticide for insect and disease control. 14 days to harvest.
		Bumper 418 EC	300 mL (121 mL)	
	pyraclostrobin	Headline EC	400–600 mL (160–240 mL)	Ground application only. Use a minimum water volume of 100 L/ha. For optimal disease control, begin applications prior to disease development. Do not graze treated crop within 6 days of last application. 7 days to harvest. Maximum of 2 applications/yr.

3. Soybeans

INSECTS

Table 3–1. Chemical Control Options for Insects in Soybeans

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (Days to harvest, label precautions, etc.)
SEEDCORN MAGGOT *(Delia platura)*				
Seed Treatment			**per 100 kg seed**	
Consider insecticide seed treatments in early planted fields where large amounts of manure, green manure or residue have been recently incorporated or when cool backward emergence conditions are expected. Expect only 60%–70% control with seed treatments applied on-farm.	**For all seed treatments use full rate and ensure good coverage of seed.**			
	diazinon + captan	Agrox B-2	340 g	Available as 2-kg container that will treat 625 kg of soybean seed. Do not use on seed already treated with an insecticide. Seed within 1 month of treatment.
		Agrox CD	200 g	Available as a 600-g container that will treat 300 kg of soybean seed. Use this product only on seed previously treated with captan or thiram.
	thiamethoxam	Cruiser 5 FS	50–83 mL	**For use in commercial seed treaters only.** Use higher rate when insect populations are expected to be high. Do not graze or feed livestock on treated areas for 45 days after planting.
SLUGS (Various species)				
No chemical control available. Slugs often avoid contact by feeding below ground, and rainfall easily washes the material from the leaves. Removing crop residue will help expose slugs to the elements. Tillage will also disturb their habitat and expose them to predators.				
See OMAFRA Publication 811, *Agronomy Guide for Field Crops*, for rotation and tillage recommendations.				

Table 3–1. Chemical Control Options for Insects in Soybeans (continued)

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (Days to harvest, label precautions, etc.)
SOYBEAN APHID *(Aphis glycines)*				
Seed Treatment			**per 100 kg seed**	
Foliar treatments at threshold is the recommended method of control. However, if using seed treatments for the control of other soil insect pests, early season protection (up to 40 days after planting) from early infestations of soybean aphids may be experienced.	thiamethoxam	Cruiser 5 FS	83 mL	**For use in commercial seed treaters only.** Provides only early season protection against soybean aphids and will not protect crop against typical mid-to-late-season aphid infestations.
Foliar Treatment			**per ha (per ac)**	
Foliar treatment is the recommended method of control for soybean aphids. Aphid infestations are more likely to cause yield reduction if the plants are already suffering from drought conditions or another stress factor.	cyhalothrin-lambda	Matador 120 E	83 mL (34 mL)	**Ground application only.** For best results, apply during the early morning, before temperatures rise, and during the evening, past the heat of the day. Use 100–200 L water/ha. Maximum of 3 applications/yr. 21 days to harvest. Do not re-enter treated areas until 24 hr of treatment.
Scout fields frequently. Apply foliar insecticide when threshold of "250 aphids per plant with increasing populations" has been reached in the R1-R5 stage of soybeans. If aphid populations do not appear to be on the increase above 250 per plant, do not apply insecticide, as it will kill off the beneficial insects that are keeping the aphid population in check. Aphids are then likely to increase quickly in the absense of their predators and could easily reach threshold. See the OMAFRA website for more information on scouting techniques, OMAFRA weekly scouting results, thresholds and management options, as well as the Ontario Soybean Growers website at www.soybean.on.ca.	dimethoate	Cygon 480	1 L (400 mL)	Use high volume, high pressure and ensure good coverage. Do not feed or allow livestock to graze on treated forage. Do not apply within 30 days of harvest.
		Lagon 480 EC	1 L (400 mL)	
TWO-SPOTTED SPIDERMITES *(Tetranychus uricae)*			**per ha (per ac)**	
Scout fields around the first week of July. Infestations usually move in from edge of field as hot spots. Spot spray when populations average 4 mites per leaf. Do not use a pyrethroid insecticide (e.g., Matador) for the control of spidermites, as it will kill the beneficial mites and cause the spidermite populations to increase.	dimethoate	Cygon 4 E	1 L (400 mL)	Do not feed or allow livestock to graze treated forage. No more than 2 applications per season. 30 days to harvest.
		Lagon 480 EC	1 L (400 mL)	
POTATO LEAFHOPPER *(Empoasca fabae)*			**per ha (per ac)**	
Potato leafhoppers are controlled in soybeans by plant resistance via leaf pubescence. Problems are rare in soybeans in Ontario. **Food grade soybeans may need protection.**	dimethoate	Cygon 4 E	0.7–1 L (280–400 mL)	Do not feed or allow livestock to graze treated forage. No more than three applications per season. 30 days to harvest.
		Lagon 480 EC	0.7–1 L (280–400 mL)	

Table 3–1. Chemical Control Options for Insects in Soybeans (continued)

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (Days to harvest, label precautions, etc.)
BEAN LEAF BEETLE *(Certoma trifurcata)*				
Seed Treatment			**per 100 kg seed**	
Seed treatment recommended only for those fields with a history of early season infestation from overwintering adults. Fields in Essex and Kent Counties in particular tend to experience injury to the seedling crop from early infestations of beetles.	thiamethoxam	Cruiser 5 FS	83 mL	**For use in commercial seed treaters only.** To reduce early season defoliation.
Foliar Treatment			**per ha (per ac)**	
Rarely do bean leaf beetle populations cause enough defoliation to require an insecticide application in Ontario. Defoliation thresholds during the R1-R5 stage are available in the OMAFRA Publication 811, *Agronomy Guide for Field Crops*. Food-grade and seed soybeans may require protection, especially during the later R5 and R6 pod stages to reduce pod disease development caused by beetle feeding. If 10% of pods have feeding damage, insecticide may be necessary. Pay attention to preharvest intervals when spraying during the R6 stage of soybeans.	cyhalothrin-lambda	Matador 120 E	83 mL (34 mL)	**Ground application only.** For best results, apply during the early morning, before temperatures rise, and during the evening, past the heat of the day. Use 100–200 L water/ha. Maximum of 3 applications/yr. 21 days to harvest. Do not re-enter treated areas until 24 hr of treatment.
	dimethoate	Cygon 4 E	0.7–1 L (280–400 mL)	Do not feed or allow livestock to graze treated forage. No more than 3 applications per season. 30 days to harvest.
		Lagon 480 EC	0.7–1 L (280–400 mL)	

Table 3–2. Soybean Seed and Soil-Applied Fungicide Recommendations

Active Ingredients	Product	Formulation	Soybean Diseases				
			Phytophthora	Pythium Damping-Off	Phomopsis Seed Mould	Rhizoctonia Damping-Off	Fusarium Seedling Blight
Insect and Disease Control							
Untreated Seed							
diazinon + captan	Agrox B-2	P (DB)	—	—	+	—	+
Seed Pretreated With Fungicide							
diazinon + captan	Agrox CD	P (DB)	For insect control only. Disease control via fungicide pretreatment.				
Disease Control							
captan	Captan	F	—	—	+	—	+
carbathiin + thiram	Anchor	F (DB)	—	—	+	+	+
carbathiin + thiram	Vitaflo-280	F	—	—	+	+	+
fludioxonil	Maxim 480 FS	F	—	—	+	+	+
fludioxonil + metalaxyl-M	Apron Maxx RTA	F	—	+	+	+	+
metalaxyl	Allegiance FL	F	+	+	—	—	—
metalaxyl	Apron FL	F	+	+	—	—	—
metalaxyl-M	Apron XL	LS	+	+	—	—	—

DB = Drill Box Application **F = Flowable** **P = Powder** **LS = Liquid Suspension**

+ = Recommended for disease listed **— = NOT recommended**

Table 3–3. Chemical Control Options for Diseases in Soybeans

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (Days to harvest, label precautions, etc.)
SOYBEAN CYST NEMATODE *(Heterodera glycines)*				
SCN is often confused with other common problems such as nutrient deficiencies, herbicide injury, soil compaction, drought, flooding or root rots. By the time above-ground symptoms from SCN feeding become noticeable, most fields have lost 25%–30% yield potential to the nematode. Early detection through scouting and soil testing is critical. If you suspect SCN, plants should be carefully dug (not pulled) and soil gently removed from the roots. Cysts are white to yellow and about the size of a pinhead. Rotating non-host crops such as corn, wheat, alfalfa or vegetable crops such as tomatoes, with resistant varieties, will lower SCN populations and improve yields on SCN-infested fields. In addition, rotation of SCN-resistant varieties is recommended to reduce shifts in the nematode population.				
PHYTOPHTHORA ROOT ROT *(Phytophthora sojae)*				
Seed Treatment			**per 100 kg seed**	
Select soybean varieties that have both specific resistance (Rps genes such as 1K and 1C) and good partial resistance (tolerance) to all races of *Phytophthora*. Consult with your seed company for variety profiles. Primarily controlled through resistant varieties. Losses are greatest in cold, wet, clay soils. Minimize soil compaction and remove excess moisture through increased drainage. A small amount of tillage will help warm soil and increase surface drainage. Rotate with corn and wheat. Plant when soil temperatures are above 13°C (55°F). Treat seed with metalaxyl or metalaxyl-M (higher rate).	metalaxyl-M	Apron XL-LS	40 mL	Do not use in hopper-box, planter-box, slurry-box or other non-commercial seed treatment applications at or immediately before planting. Do not graze or feed livestock on seeded area for 4 weeks after planting. Read label for information regarding resistant strains of fungus.
	metalaxyl	Allegiance FL	46–93 mL	Do not graze or feed livestock on seeded area for 4 weeks after planting.
		Apron FL	46–93 mL	
PHOMOPSIS SEED MOULD *(Phomopsis longicolla)*				
Seed Treatment			**per 100 kg seed**	
Most severe when cool, wet conditions delay harvest. Some varieties are more susceptible than others. Fungicide seed treatments will improve the germination of low to moderately infected seed. Do not plant severely infected seed. Plant good quality seed with a germination rate of at least 80%–90%. Rotate with non-host crops such as corn and wheat, remove excess surface residue and harvest as early as possible.	carbathiin + thiram	Anchor	600 mL	Drill box application. Ensure uniform coverage on seed. Do not apply Anchor through commercial seed treating equipment or through an auger, as excessive seed wetness may result. Do not graze or feed livestock on treated areas for 4 weeks after planting.
		Vitaflo 280	260 mL	Do not store treated soybean seed. May be applied through commercial seed treatment equipment or auger. Ensure uniform coverage.
	captan	Captan Flowable	280 mL	Mix with the amount of water required for the slurry treater equipment to be used.
	fludioxonil	Maxim 480 FS	5.2–10.4 mL	**For commercial application only.** Do not use in hopper-box, planter-box, slurry-box or other non-commercial seed treatment applications at or immediately before planting. Do not graze treated crops or cut for forage within 30 days of planting.
	fludioxonil + metalaxyl-M	Apron Maxx RTA	325 mL	For both commercial seed treatment plants and on-farm treatment using standard gravity or mist-type seed treatment equipment. Compatible with *Rhizobium*-based inoculants. Check with inoculant manufacturers prior to use. Ensure uniform coverage.

Table 3–3. Chemical Control Options for Diseases in Soybeans (continued)

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (Days to harvest, label precautions, etc.)
RHIZOCTONIA DAMPING-OFF *(Rhizoctonia solani)*				
Seed Treatment			**per 100 kg seed**	
Can occur on all soil types and environmental conditions. Disease losses are greatest when a dry spring is followed by wet conditions. Few management options exist since no resistant or tolerant varieties are available. Seed treatment and crop rotation with corn and small grains can help minimize the disease.	fludioxonil	Maxim 480 FS	5.2–10.4 mL	**For commercial application only.** Do not use in hopper-box, planter-box, slurry-box or other non-commercial seed treatment applications at or immediately before planting.
	fludioxonil + metalaxyl-M	Apron Maxx RTA	325 mL	For both commercial seed treatment plants and on-farm treatment using standard gravity- or mist-type seed treatment equipment. Compatible with Rhizobium-based inoculants. Check with inoculant manufacturers prior to use. Ensure uniform coverage.
	carbathiin + thiram	Anchor	600 mL	Drill box application. Ensure uniform coverage on seed. Do not apply Anchor through commercial seed treating equipment or through an auger, as excessive seed wetness may result. Do not graze or feed livestock on treated areas for 4 weeks after planting.
		Vitaflo 280	260 mL	Do not store treated soybean seed. May be applied through commercial seed treatment equipment or auger. Ensure uniform coverage.
PYTHIUM DAMPING-OFF *(Pythium* spp.*)*				
Seed Treatment			**per 100 kg seed**	
Can occur on all soil types but losses are greatest in cold, wet, clay soils. Minimize soil compaction and remove excess moisture through increased drainage. Plant when soil temperatures are above 13°C (55°F). Treat seed with metalaxyl or metalaxyl-M. No known resistance but some degree of tolerance available in cultivars. Rotation has limited affect. Pythium control less affected by rate.	fludioxonil + metalaxyl-M	Apron Maxx RTA	325 mL	For both commercial seed treatment plants and on-farm treatment using standard gravity- or mist-type seed treatment equipment. Compatible with Rhizobium-based inoculants. Check with inoculant manufacturers prior to use. Ensure uniform coverage.
	metalaxyl	Allegiance FL	46–93 mL	Do not graze or feed livestock on seeded area for 4 weeks after planting.
		Apron FL	46–93 mL	
	metalaxyl-M	Apron XL LS	20–40 mL	Do not use in hopper-box, planter-box, slurry-box or other non-commercial seed treatment applications at or immediately before planting. Do not graze or feed livestock on seeded area for 4 weeks after planting. Read label for information regarding resistant strains of fungus.

Table 3–3. Chemical Control Options for Diseases in Soybeans (continued)

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (Days to harvest, label precautions, etc.)
FUSARIUM SEEDLING BLIGHT *(Fusarium oxysporum* or *Fusarium solani)*				
Seed Treatment			**per 100 kg seed**	
Cool, wet spring conditions favour infection. Resistant varieties not available. Minimize soil compaction and remove excess moisture through increased drainage. A small amount of tillage will help warm soil and increase surface drainage. Rotate with corn and wheat. Plant high-quality seed when soil temperatures are above 13°C (55°F). Fungicide seed treatment recommended. Mounding or ridging soil at the base of the plants produces adventitious roots that can minimize losses.	fludioxynil	Maxim 480 FS	5.2–10.4 mL	**For commercial application only.** Do not use in hopper-box, planter-box, slurry-box or other non-commercial seed treatment applications at or immediately before planting.
	fludioxonil + metalaxyl-M	Apron Maxx RTA	325 mL	For both commercial seed treatment plants and on-farm treatment using standard gravity- or mist-type seed treatment equipment. Compatible with Rhizobium-based inoculants. Check with inoculant manufacturers prior to use. Ensure uniform coverage.
	carbathiin + thiram	Anchor	600 mL	Drill box application. Ensure uniform coverage on seed. Do not apply Anchor through commercial seed treating equipment or through an auger, as excessive seed wetness may result. Do not graze or feed livestock on treated areas for 4 weeks after planting.
		Vitaflo 280	260 mL	Do not store treated soybean seed. May be applied through commercial seed treatment equipment or auger. Ensure uniform coverage.
	diazinon + captan	Agrox B-2	320 g	Available as a 2-kg container that will treat 625 kg of soybean seed. Use full rate and ensure good coverage of seed. Seed within 1 month of treatment. Do not use on seed already treated with an insecticide.
	captan	Captan Flowable	280 mL	Mix with the amount of water required for the slurry treater equipment to be used.
WHITE MOULD *(Sclerotinia sclerotiorum)*				
Foliar Treatment				
White mould is a sporadic disease that thrives under cool, wet conditions during flowering or near harvest. Fields at risk have a history of white mould, good leaf growth and high populations and more than 48 hr of continuous wetness and air temperatures between 15°C and 20°C (day and night average temperatures). In fields with a history of white mould, use non-host crops and avoid growing other host crops such as canola, edible beans, buckwheat and sunflowers for 2–3 years, plant a tolerant variety although none are resistant (immune), plant a variety with good lodging resistance and keep sclerotia on the surface through conservation tillage practices.				No registered products available at this time.

Table 3–3. Chemical Control Options for Diseases in Soybeans (continued)

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (Days to harvest, label precautions, etc.)
ASIAN SOYBEAN RUST *(Phakopsora pachyrhizi)*				
Foliar Treatment			**per ha (per ac)**	
Asian soybean rust is a new invasive fungal disease of soybean in North America. Scouting and early detection are critical to managing this disease. The early stages of the disease can be confused with other common foliar diseases such as septoria brown spot, bacterial pustule, downy mildew, frog-eye leaf spot and bacterial blight. Numerous factors such as crop stage (R1 to R6), yield potential, disease risk or presence are critical components of the fungicide decision process. Strobilurin fungicides such as Headline or Quadris are protective products that stop spore germination and penetration into the soybean leaf. The strobilurins have no effect on the fungus once inside the leaf. Since the stobilurin group of fungicides have NO curative activity, do not make solo applications of a strobilurin if any rust is present. The triazole fungicides such as Tilt and Folicur have varying protective abilities and are usually considered "early post-infection" fungicides. The post infection or curative abilities are limited, and the fungicides may not perform well if 5%–10% disease is present in the lower crop canopy. Combination products containing both a strobulurin and triazole fungicide such as Quilt have preventative (pre-infection) and curative (post-infection) properties. Yield loss is very likely once rust can be found in the mid-crop canopy. For these reasons, scouting, fungicide selection, timing and application are critical to successful management of soybean rust. For further information on scouting techniques, sentinel plots, thresholds, management options and emergency use registrations, see the OMAFRA website, as well as the Ontario Soybean Growers website at: www.soybean.on.ca.	pyraclostrobin	Headline EC	400–600 mL (160–240 mL)	Ground and aerial application. Maximum of 2 applications per year. Classified as a strobilurin fungicide and therefore needs to be used in a preventative fungicide program (pre-infection). See label for resistance management strategy. 21 days to harvest interval. 48-hr re-entry period.
	azoxystrobin	Quadris	500 mL (200 mL)	Ground and aerial application. Maximum of 2 applications per year. Classified as a strobilurin fungicide and therefore needs to be used in a preventative fungicide program (pre-infection). See label for resistance management strategy. 15 days to harvest interval.
	propiconazole	Tilt 250 E	500–750 mL (200–300 mL)	Ground and aerial application. Make first application at the first sign of disease followed by a second application 14 days after the first application if environmental conditions are favourable for disease development. Maximum of 2 applications per year. See label for resistance management strategy. 30 days to harvest interval.
	azoxystrobin + propiconazole	Quilt	1.0–1.5 L (400–600 mL)	Ground and aerial application. Make the first application at the first sign of disease. Apply the high rate only under conditions of high disease pressures. A second application at a 14-day interval may be needed if conditions persist. Good spray coverage and canopy penetration are important for best results. Apply in a minimum of 45 L of water per hectare. Maximum of 2 applications per year. See label for resistance management strategy. 30 days to harvest interval.

Table 3–3. Chemical Control Options for Diseases in Soybeans (continued)

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (Days to harvest, label precautions, etc.)
FROG-EYE LEAF SPOT *(Cercospora sojina)*				
Foliar Treatment			**per ha (per ac)**	
Economic impact is minimal. Frog-eye leaf spot occurs under hot, humid conditions particularly on very susceptible varieties. The disease is most frequent in the extreme southwest counties.	pyraclostrobin	Headline EC	400–600 mL (160–240 mL)	Ground and aerial application. Maximum of 2 applications per year. Make first application at the first sign of disease followed by the second application 14 days after if environmental conditions are favourable for disease development. 21 days to harvest interval. 48 hr re-entry period.
	propiconazole	Bumper 418 EC	300–455 mL (121–184 mL)	**For soybeans grown for seed only.** Ground application only. Apply when disease first appears. Under severe disease pressure, make a second application 14 days after. 50 days to harvest interval. Soybean seed should not be used for human or animal consumption.
		Tilt 250 E	500–760 mL (200–308 mL)	**For soybeans grown for seed only.** Ground application only. Apply when disease first appears. Under severe disease pressure, make a second application 14 days after. 30 days to harvest interval. Soybean seed should not be used for human or animal consumption.

4. Forages

INSECTS

Table 4–1. Chemical Control Options for Insects in Forage Crops

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (Days to harvest, label precautions, etc.)
ALFALFA SNOUT BEETLE *(Otiorhynchus ligustici)*				
No chemical control available. See OMAFRA Publication 811, *Agronomy Guide for Field Crops*, for management information.				
ALFALFA WEEVIL *(Hypera postica Gyll)*			**per ha (per ac)**	
First Cut: If 40% of the stems have feeding damage in the tips, cut and remove from fields as soon as possible. If this level of damage occurs a week or more before optimum cutting time, spray may be necessary. **Second Cut:** If damage was serious on first cut, feeding may continue and early re-growth should be carefully checked. Natural enemies are generally highly effective at controlling this pest. For the safety of these natural enemies, chemical control is not recommended unless pest population exceeds the action threshold. See OMAFRA Publication 811, *Agronomy Guide for Field Crops*, for more information on action thresholds.	cyhalothrin-lambda	Matador 120 E	83 mL (34 mL)	Alfalfa only. Ground or aerial application. Apply when larvae are small and populations are high. Maximum of 3 applications per year, 1 may be by air. Allow 7 days between treatments. Do not apply within 3 days of livestock grazing. Alfalfa seed from treated crop is not to be used for production of alfalfa sprouts for human consumption. 24-hr re-entry period.
	phosmet	Imidan 50 WP	2.25 kg (900 g)	Alfalfa only. Ground application only. Do not apply during bloom. Only 1 application per cutting. 7 days to cutting or grazing.
POTATO LEAFHOPPER *(Empoasca fabae)*			**per ha (per ac)**	
Leafhoppers are most severe in new seedings and in regrowth under hot dry weather. Some resistant varieties having glandular hairs on the leaves and stems have been found to be effective. Use chemical control only if leafhoppers exceed the threshold, as insecticides will also kill effective natural enemies of alfalfa weevil. See OMAFRA Publication 811, *Agronomy Guide for Field Crops*, for threshold charts.	dimethoate	Cygon 480 EC	425 mL (170 mL)	Alfalfa, forage and pasture. Ground and aerial application. Do not apply during bloom. 2 days to harvest and grazing. No more than 2 applications per season.
		Lagon 480 EC	425 mL (170 mL)	
	cyhalothrin-lambda	Matador 120 E	83 mL (34 mL)	Alfalfa only. Ground or aerial application. Apply when larvae are small and populations are high. Maximum of 3 applications per year, 1 may be by air. Allow 7 days between treatments. Do not apply within 3 days of livestock grazing. Alfalfa seed from treated crop is not to be used for production of alfalfa sprouts for human consumption. 24-hr re-entry period.
EUROPEAN SKIPPER *(Thymelicus lineola)*			**per ha (per ac)**	
If 6–8 caterpillars in a 30-cm x 30-cm area are found as early as the brown-headed stage, treat the field or the infested area. See OMAFRA Publication 811, *Agronomy Guide for Field Crops*, for scouting procedures.	*Bacillus thuringiensis* (Bt)	Dipel 2X DF	140–275 g (60–115 g)	Timothy only. 0 days to cutting or grazing.
		Thuricide HPC	2.25 L (900 mL)	

Table 4–1. Chemical Control Options for Insects in Forage Crops (continued)

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (Days to harvest, label precautions, etc.)
GRASSHOPPERS (Various species)			**per ha (per ac)**	
Begin scouting in late June when grasshoppers are still young. Spraying insecticides on alfalfa will also kill the natural enemies of alfalfa weevil and lygus bugs.	cyhalothrin-lambda	Matador 120 E	63–83 mL (26–34 mL)	Alfalfa only. Ground or aerial application. Apply when larvae are small and populations are high. Maximum of 3 applications per year, 1 may be by air. Allow 7 days between treatments. Do not apply within 3 days of livestock grazing. Alfalfa seed from treated crop is not to be used for production of alfalfa sprouts for human consumption. 24-hr re-entry period.
	malathion	Malathion 500 EC	2.25–2.75 L (0.9–1.1 L)	For alfalfa and clover. Do not apply during bloom. Apply when 75% of foliage shows feeding damage. Less effective below 20°C (68°F). 7 days to cutting or grazing.
ALFALFA BLOTCH LEAFMINER *(Agromyza frontella)*			**per ha (per ac)**	
Natural enemies are highly effective at controlling this pest. For the safety of these natural enemies, chemical control is not recommended unless pest population exceeds the action threshold. See OMAFRA Publication 811, *Agronomy Guide for Field Crops*, for more information.	dimethoate	Cygon 480 E	550 mL (220 mL)	Alfalfa only. Ground and aerial application. Do not apply during bloom. Use at least 200 L/ha of water for ground application. No more than 2 applications/season. 2 days to cutting or grazing.
		Lagon 480 E	550 mL (220 mL)	
	phosmet	Imidan 50 WP	2.25 kg (900 g)	Alfalfa only. Do not apply during bloom. Spray when first signs of infestation are visible. 7 days to cutting or grazing.
ARMYWORM (TRUE – *Pseudaletia unipuncta*, FALL – *Spodoptera frugiperda*)			**per ha (per ac)**	
If 50% of the plants are infested with unparasitized larvae smaller than 2.5 cm (1 in.), insecticide may be warranted. If larvae have white eggs attached to them, they are parasitized and may not need treatment. If the larvae are almost full grown (about 4 cm or 1½ in. long), there is no benefit in applying insecticide since most of the feeding damage has already been done.	carbaryl	Sevin XLR Plus	2.5–5.25 L (1.0–2.1 L)	Alfalfa, clover and forage grasses. 2 days to harvest.

Table 4–2. Chemical Control Options for Diseases in Forage Crops

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (Days to harvest, label precautions, etc.)
SEED AND ROOT ROTS				
PHYTOPHTHORA ROOT ROT *(Phytophthora medicaginis)*				
Seed Treatment			**per 100 kg seed**	
Plant resistant varieties that are treated with metalaxyl or metalaxyl-M. Drain excess moisture and avoid compaction. Avoid stresses such as insects, weeds and untimely cuttings that may stress the plants and make them more susceptible to Phytophthora. Do not cut during wet conditions. Crop rotation has little affect on the disease. Promote lateral root growth with good fertility program.	metalaxyl-M	Apron XL LS	40 mL	For alfalfa, clover, and forage grasses. Do not use in hopper-box, planter-box, slurry-box or other non-commercial seed treatment applications at or immediately before planting. Do not graze or feed livestock on seeded area for 4 weeks after planting. Read label for information regarding resistant strains of fungus.
	metalaxyl	Allegiance FL	46–110 mL	Do not graze or feed livestock on seeded area for 4 weeks after planting.
		Apron FL	46–110 mL	
PYTHIUM DAMPING-OFF (*Pythium* spp.)				
Seed Treatment			**per 100 kg seed**	
Drain excess moisture and avoid compaction. Plant when soil and weather conditions favour rapid emergence and early growth of seedlings. Increase plant populations to compensate for any plant losses.	metalaxyl-M	Apron XL LS	20–40 mL	Use 20–40 mL for forage grasses.
			40 mL	Use 40 mL for alfalfa, clover, trefoil and vetch.
				Do not use in hopper-box, planter-box, slurry-box or other non-commercial seed treatment applications at or immediately before planting. Do not graze or feed livestock on seeded area for 4 weeks after planting. Read label for information regarding resistant strains of fungus.
	metalaxyl	Allegiance FL	46–110 mL	Do not graze or feed livestock on seeded area for 4 weeks after planting.
		Apron FL	46–110 mL	
FOLIAR AND STEM DISEASES				
VERTICILLIUM WILT *(Verticillium albo-atrum)*				
Seed Treatment			**per 100 kg seed**	
Planting resistant or highly resistant varieties is the best means of control. The fungus is spread primarily on the cutting bar of forage harvesting equipment. Before harvesting, clean the cutting bar with a 1% solution of bleach followed by a clean water rinse and oil spray. Cut the youngest fields first, working towards the oldest fields. Wait 2–3 years between alfalfa crops. Maintain a good weed control program, since some weeds can be alternate hosts.	thiram	Thiram 75 WP	360 g	Alfalfa only. Do not graze treated areas or feed clippings from treated areas to livestock.
WHITE MOULD/BLOSSOM BLIGHT *(Sclerotinia sclerotiorum/Botrytis cinerea)*				
Foliar Treatment			**per ha (per ac)**	
Some differences in susceptibility between cultivars exist. Fields established under minimum tillage may have more disease. Spring planting may reduce incidence.	boscalid	Lance	420 g (170 g)	**For seed production only.** Ground and aerial application. Apply at 20%–50% flowering. Apply every 7–14 days if disease persists or weather conditions are favourable for disease development. Do not graze or feed treated hay to livestock. Maximum of 3 applications per year.

Table 4–2. Chemical Control Options for Diseases in Forage Crops (continued)

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (Days to harvest, label precautions, etc.)
COMMON LEAF SPOT *(Pseudopeziza medicaginis)*				
Foliar Treatment			**per ha (per ac)**	
Timely harvesting of forages is important to reduce leaf loss and minimize disease in the regrowth. There are no practical control strategies available for leaf spot diseases in forages. Leaf spots can reduce the protein level in legume leaves, so it is important to balance the time of harvest between the optimum stage for highest protein (bud stage in alfalfa) and the level of leaf spot disease.	boscalid	Lance	420 g (170 g)	**For seed production only.** Ground and aerial application. Apply at 20%–50% flowering. Apply every 7–14 days if disease persists or weather conditions are favourable for disease development. Do not graze or feed treated hay to livestock. Maximum of 3 applications per year.
	mancozeb	Dithane DG Rainshield NT	1.46 kg (584 g)	**For seed production only.** Apply prior to 50% bloom. Maximum of 3 applications/yr. Repeat 7–10 days after first application and 10 days after second application. Do not graze treated crop or cut for hay.
LEAF SPOT *(Leptosphaerulina trifolii)*				
Foliar Treatment			**per ha (per ac)**	
Timely harvesting of forages is important to reduce leaf loss and minimize disease in the regrowth. There are no practical control strategies available for leaf spot diseases in forages. Leaf spots can reduce the protein level in legume leaves, so it is important to balance the time of harvest between the optimum stage for highest protein (bud stage in alfalfa) and the level of leaf spot disease.	boscalid	Lance	420 g (170 g)	**For seed production only.** Ground and aerial application. Apply at 20%–50% flowering. Apply every 7–14 days if disease persists or weather conditions are favourable for disease development. Do not graze or feed treated hay to livestock. Maximum of 3 applications per year.
	mancozeb	Dithane DG Rainshield NT	1.46 kg (584 g)	**For seed production only.** Apply prior to 50% bloom. Maximum of 3 applications/yr. Repeat 7–10 days after first application and 10 days after second application. Do not graze treated crop or cut for hay.
SPRING BLACK STEM *(Phoma medicaginis)*				
Foliar Treatment			**per ha (per ac)**	
Disease is favoured by cool, wet weather conditions. Cut early to reduce quality loss from premature leaf drop.	boscalid	Lance	420 g (170 g)	**For seed production only.** Ground and aerial application. Apply at 20%–50% flowering. Apply every 7–14 days if disease persists or weather conditions are favourable for disease development. Do not graze or feed treated hay to livestock. Maximum of 3 applications per year.

5. Cereals

INSECTS

Table 5–1. Chemical Control Options for Insects in Cereals

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (Days to harvest, label precautions, etc.)
WHEAT, BARLEY, OATS and RYE				
WIREWORMS (*Limonius* spp. and others)				
Seed Treatment			**per 100 kg seed**	
See OMAFRA Publication 811, *Agronomy Guide for Field Crops*, for sampling methods. 1 wireworm per bait trap warrants control.	thiamethoxam	Cruiser 5 FS	33–50 mL	For wheat and barley. **For use in commercial seed treaters only.** Use higher rate in fields with history of high infestations of larvae. Refer to label for resistance management strategies.
EUROPEAN CHAFER *(Rhizotrogus majalis)*				
High-risk areas are sandy knolls and areas bordering turf, pasture and tree lines. Chafer grubs can follow soybean crops on sandy soils. Avoid planting winter wheat if chafer grubs are easily found. See OMAFRA Publication 811, *Agronomy Guide for Field Crops*, for more details.				No registered products available at this time.
ARMYWORM (TRUE – *Pseudaletia unipuncta*, FALL – *Spodoptera frugiperda*)			**per ha (per ac)**	
5 to 6 larvae in an area 30 x 30 cm warrant chemical control. Treat if larvae <2.0 cm long and threshold has been exceeded. If larvae have white eggs attached to them, they are parasitized and may not need treatment.	trichlorfon	Dylox 420 LC	1.5 L (0.6 L)	Ground application only. Wheat, barley and oats. 21 days to harvest
	carbaryl	Sevin XLR Plus	2.5–5.25 L (1.0–2.1 L)	14 days to harvest for wheat, rye and oats. 28 days to harvest for barley. See label precautions applying to honeybees.
	methomyl	Lannate Toss-N-Go	270–540 g (108–216 g)	Ground and aerial application. 20 days to harvest. Minimum period before re-entry is 24 hr.
CEREAL LEAF BEETLE *(Oulema melanopus)*			**per ha (per ac)**	
Natural enemies are highly effective at controlling this pest. For the safety of these natural enemies, chemical control is not recommended unless pest population exceeds the action threshold of 1 larvae per stem. See OMAFRA Publication 811, *Agronomy Guide for Field Crops*, for more information.	malathion	Malathion 500 EC	2.2 L (880 mL)	7 days to harvest. Less effective below 20°C (68°F).

Table 5–1. Chemical Control Options for Insects in Cereals (continued)

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (Days to harvest, label precautions, etc.)
GRASSHOPPERS (Various species)			**per ha (per ac)**	
More abundant in dryer years. If populations are high enough, wheat heads may be clipped. Seedling winter wheat is also at risk. Infestations usually begin along field borders. Early-season weed control can help eliminate food source for early-season nymphs, however, late-season weed control in and around the field will actually cause this insect to migrate from the weeds onto the crop and cause damage. If populations are high, spot spray in border areas that are infested before migration into the field occurs.	malathion	Malathion 500 EC	2.25–2.75 L (900–1,100 mL)	7 days to harvest. Less effective below 20°C (68°F).
	cypermethrin	Ripcord 400 EC	50–70 mL (20–28 mL)	Ground and aerial application. Use lower rates for small grasshoppers and when soil temperatures are cool (15°C–20°C). Avoid spraying when temperatures are above 25°C. Repeat treatment as necessary. Do not graze treated crop or cut for hay 60 days to harvest.
	cyhalothrin-lambda	Matador 120 E	63–83 mL (26–34 mL)	Ground or aerial application. Apply the low rate when grasshoppers are up to the 3rd nymphal stage (up to 1 cm in length) or when insect numbers are low. Apply the high rate when grasshoppers are larger, up to but not including winged adults (up to 2.5 cm in length) or when insect numbers are high. 3 applications/yr. 2 may be by air. Allow a 7-day interval between treatments. In wheat, do not apply within 28 days of harvest or 14 days of livestock foraging. In barley and oats do not apply within 28 days of harvest or 14 days of livestock foraging.
	carbaryl	Sevin XLR Plus	1.25–2.5 L (0.5–1.0 L)	14 days to harvest for wheat, rye and oats. 28 days to harvest for barley. See label precautions applying to honeybees.
GROWTH REGULATORS FOR LODGING REDUCTION IN CEREALS			**per ha (per ac)**	
Visit the OMAFRA website for performance trial information. High-risk factors include fields with a history of manure applications and legume hay.	ethephon	Ethrel	**Spring Barley** 1.0–1.5 L (0.4–0.6 L) *2-row cultivar* 1.0–2.0 L (0.4–0.8 L) *6-row cultivar* **Spring Wheat** 1.0–1.5 L (0.4–0.6 L) **Winter Wheat** 1.25–2.5 L (0.5–1.0 L)	Ground and aerial application. Correct timing is critical. Use lower rates unless lodging conditions are expected to be severe. Apply when most of the tillers are between early flag leaf emergence to swollen boot stage (Zadok's 37 to 45). Do not apply after more than 10% of the awns have emerged (Zadok's 49). Use higher rates on crops that are heavily fertilized (more than 100 kg/ha of total available nitrogen) and have ample moisture (more than 25 cm of precipitation) and are prone to lodging. Do not apply within 35 days of harvest.

Table 5–2. Wheat Seed and Soil-Applied Fungicide Recommendations

Active Ingredient	Products	Formulation	Wheat Diseases											
			Seed-Borne				Soil-Borne						Early Season	
			Loose Smut	Seed-Borne Septoria	Seed-Borne Fusarium	Seed-Borne Dwarf Bunt	Soil-Borne Dwarf Bunt	Common Bunt	Common Root Rot	Take All	Pythium Damping-Off	Soil-Borne Fusarium	Powdery Mildew	Septoria
carbathiin + thiram	Vitaflo 280	F	+	—	+	+	—	+	+	—	—	+	—	—
difenoconazole + metalaxyl-M	Dividend XL	F	+	+	+	+	+	+	+[1]	+[1]	+	+	—	+[1]
difenoconazole + metalaxyl-M	Dividend XL RTA	F	+	+	+	+	+	+	+[1]	+[1]	+	+	—	+[1]
metalaxyl-M	Apron XL	F	—	—	—	—	—	—	—	—	+	—	—	—
tebuconazole + thiram	Raxil T	F	+	+	+	—	—	+	+[1]	—	+	+	—	—
triticonazole + thiram	Gemini	F	+	—	+	—	—	+	—	—	+	—	—	—
triadimenol	Baytan 30	F	+	—	—	—	—	+	—	+[1]	—	—	+	—

DB= Drill Box Application EC = Emulsifiable Concentrate F= Flowable P= Powder

+ = Recommended for disease listed — = Not Recommended

[1] Suppression only.
[2] Winter wheat only.

Table 5–3. Chemical Control Options for Diseases in Wheat

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (Days to harvest, label precautions, etc.)
SEED ROTS AND SEED-BORNE DISEASES				
Use good-quality, clean seed. All wheat seed needs to have a fungicide seed treatment applied to control soil-borne and seed-borne diseases such as seed rots and seedling blights, seed-borne Septoria, seed-borne Fusarium seedling blight, seed-borne dwarf bunt, common bunt and loose smut. The best protection against seedling blights, smut and the bunts can be achieved through the use of a seed treatment that contains a combination of fungicides, since no one fungicide is affective against all these diseases. Good coverage of the seed is essential since its performance will be reduced.				
SEED-BORNE SEPTORIA *(Stagonospora nodorum*, formerly *Septoria nodorum)*				
Seed Treatment			**per 100 kg seed**	
Infected seed is lightweight and shrivelled. Fungicide seed treatment is very effective against this disease. Other options include the use of tolerant varieties and disease-free seed. Plant into a well-prepared seed bed under good growing conditions. Use wheat in at least a 3-yr rotation since the disease can survive in wheat residue.	difenoconazole + metalaxyl-M	Dividend XL RTA	650 mL	For both commercial seed treatment plants and on-farm treatment using standard gravity flow- or mist-type seed treatment equipment. May also be used in treat-on-the-go seeder. Do not graze, feed green forage or cut for hay within 35 days of planting.
	tebuconazole + thiram	Raxil T	225 mL	Do not graze or feed livestock on treated areas for 4 weeks after planting.
FUSARIUM spp. (SEED-BORNE, SEED ROT and SEEDLING BLIGHT)				
Seed Treatment			**per 100 kg seed**	
Infected seed is lightweight and shrivelled. Fungicide seed treatment is very effective against this disease. Other options include the use of tolerant varieties and disease-free seed. Plant into a well-prepared seedbed under good growing conditions. Use wheat in at least a 3-yr rotation since the disease can survive in wheat residue. Avoid planting wheat after corn.	tebuconazole + thiram	Raxil T	225 mL	Do not graze or feed livestock on treated areas for 4 weeks after planting.
	difenoconazole + metalaxyl-M	Dividend XL RTA	325–650 mL	For both commercial seed treatment plants and on-farm treatment using standard gravity flow- or mist-type seed treatment equipment. May also be used in treat-on-the-go seeder. Do not graze, feed green forage or cut for hay within 35 days of planting.
	triticonazole + thiram	Gemini	360 mL	For both commercial seed treatment plants and on-farm treatment using standard gravity flow- or mist-type seed treatment equipment. May also be used in treat-on-the-go seeder. Do not use seed for food, feed or oil processing.
SEEDLING DISEASES				
COMMON ROOT ROT (COMMON BLIGHT) *(Cochliobolus sativus)*				
Seed Treatment			**per 100 kg seed**	
Infected plants can be found individually or in irregular patches. These plants are often stunted and yellow (chlorotic) with a dark browning or blacking of the subcrown internodes. Drought and warm temperatures favour root rot. Maintain sound soil health practices and use good 3-yr crop rotation using non-host crops. Avoid soil compaction and deep seeding.	difenoconazole + metalaxyl-M	Dividend XL RTA	325–650 mL	**For suppression only.** For both commercial seed treatment plants and on-farm treatment using standard gravity flow- or mist-type seed treatment equipment. May also be used in treat-on-the-go seeder. Do not graze, feed green forage or cut for hay within 35 days of planting.
	tebuconazole + thiram	Raxil T	225 mL	Do not graze or feed livestock on treated areas for 6 weeks after planting.
	carbathiin + thiram	Vitaflo 280	230–330 mL	For suppression only. Do not graze or feed livestock on treated areas for 6 weeks after planting.
FUSARIUM CROWN AND FOOT ROT (*Fusarium graminearum, F. culmorum, F. pseudograminearum)*				
Seed Treatment			**per 100 kg seed**	
Use of an uncontaminated source of seed is important. Crop rotation will reduce the risk of crown rot infection. Avoid planting wheat after corn. Use shallow seeding.	difenoconazole + metalaxyl-M	Dividend XL RTA	325–650 mL	**For suppression only.** For both commercial seed treatment plants and on-farm treatment using standard gravity flow- or mist-type seed treatment equipment. May also be used in treat-on-the-go seeder. Do not graze, feed green forage or cut for hay within 35 days of planting.

Table 5–3. Chemical Control Options for Diseases in Wheat (continued)

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (Days to harvest, label precautions, etc.)
PYTHIUM DAMPING-OFF *(Pythium* spp.)				
Seed Treatment			**per 100 kg seed**	
Can occur on all soil types but losses are greatest in cold, wet, clay soils. Minimize soil compaction and remove excess moisture through increased drainage. Seed treatments containing metalaxyl or metalaxyl-M can reduce infection. Delay planting until conditions will result in a rapid and uniform emergence.	difenoconazole + metalaxyl-M	Dividend XL RTA	325–650 mL	For both commercial seed treatment plants and on-farm treatment using standard gravity flow- or mist-type seed treatment equipment. May also be used in treat-on-the-go seeder. Do not graze, feed green forage or cut for hay within 35 days of planting.
	metalaxyl-M	Apron XL LS	20–40 mL	Do not use in hopper-box, planter-box, slurry-box or other non-commercial seed treatment applications at or immediately before planting. Do not graze or feed livestock on seeded area for 4 weeks after planting. Read label for information regarding resistant strains of fungus.
	triticonazole + thiram	Gemini	360 mL	For both commercial seed treatment plants and on-farm treatment using standard gravity flow- or mist-type seed treatment equipment. May also be used in treat-on-the-go seeder. Do not use seed for food, feed or oil processing.
	tebuconazole + thiram	Raxil T	225 mL	Do not graze or feed livestock on treated areas for 4 weeks after planting.
PENICILLIUM and ASPERGILLUS SEED ROT *(Penicillium* spp. and *Aspergillus* spp.)				
Seed Treatment			**per 100 kg seed**	
Both of these diseases are considered storage moulds. Their incidence increases when wheat is stored under warm temperatures and moist conditions. Seed that is damaged is especially susceptible under these conditions. Maintain grain at less than 14% moisture and below 20°C (68°F). Avoid damaging seed during harvest or handling.	difenoconazole + metalaxyl-M	Dividend XL RTA	325–650 mL	For both commercial seed treatment plants and on-farm treatment using standard gravity flow- or mist-type seed treatment equipment. May also be used in treat-on-the-go seeder. Do not graze, feed green forage or cut for hay within 35 days of planting.
DWARF BUNT *(Tilletia controversa)*				
Seed Treatment			**per 100 kg seed**	
Occurs on winter wheat, primarily in counties bordering Georgian Bay and Lake Huron where snow cover is deep and persistent in late winter and early spring. Plant seed that is free of bunt spores (black). Treat seed when bunt has been observed in the crop. Cut high with the combine. Wheat infected with dwarf bunt will be substantially shorter than healthy plants. Infected seed has a "fishy" smell. Raising the header reduces the amount of bunt balls being harvested. Coverage of the seed with fungicide seed treatments is important to their effectiveness. Avoid planting wheat into fields with soil-borne dwarf bunt for 5–7 years since the fungus is very persistent.	difenoconazole + metalaxyl-M	Dividend XL RTA	325–650 mL	For both commercial seed treatment plants and on-farm treatment using standard gravity flow- or mist-type seed treatment equipment. May also be used in treat-on-the-go seeder. Do not graze, feed green forage or cut for hay within 35 days of planting.
	carbathiin + thiram	Vitaflo 280	230–330 mL	Seed-borne only. Do not graze or feed livestock on treated areas for 6 weeks after planting.

Table 5–3. Chemical Control Options for Diseases in Wheat (continued)

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (Days to harvest, label precautions, etc.)
LOOSE SMUT *(Ustilago tritici)*				
Seed Treatment			**per 100 kg seed**	
This fungus infects the embryo at flowering, thus is seed-borne. Light rains or heavy dew and moderate temperature, 15°C–16°C (58°F–60°F), during flowering, favour infection. Sow pedigree seed. This disease was quite important in Ontario wheat production but the incidence and hence its impact have been reduced substantially due to the effectiveness of fungicide seed treatments. Good coverage of seed with fungicide seed treatment is important.	carbathiin + thiram	Vitaflo 280	330 mL	Do not graze or feed livestock on treated areas for 6 weeks after planting.
	tebuconazole + thiram	Raxil T	225 mL	Do not graze or feed livestock on treated areas for 4 weeks after planting.
	difenoconazole + metalaxyl-M	Dividend XL RTA	325–650 mL	For both commercial seed treatment plants and on-farm treatment using standard gravity flow- or mist-type seed treatment equipment. May also be used in treat-on-the-go seeder. Do not graze, feed green forage or cut for hay within 55 days of planting.
	triadimenol	Baytan 30	50 mL	Must be diluted with water prior to treatment of seed to ensure uniform coverage. Treated seed will sometimes emerge more slowly than untreated. Avoid late seeding of winter cereals. Do not graze or feed livestock on treated areas for 40 days after planting.
	triticonazole + thiram	Gemini	360 mL	For both commercial seed treatment plants and on-farm treatment using standard gravity flow- or mist-type seed treatment equipment. May also be used in treat-on-the-go seeder. Do not use seed for food, feed or oil processing.
TAKE-ALL *(Gaeumannomyces graminis)*				
Seed Treatment			**per 100 kg seed**	
Carefully manage your soil fertility. Neutral to alkaline and infertile soils are most at risk. Do not apply lime before planting. Soils deficient in potassium and phosphorus cause plants to be more susceptible because of poor root development. Nitrate nitrogen increases disease severity. Control grasses and avoid early planting. Use a 3-yr crop rotation and avoid planting wheat after wheat.	triadimenol	Baytan 30	100 mL	**Suppression only.** Must be diluted with water prior to treatment of seed to ensure uniform coverage. Treated seed will sometimes emerge more slowly than untreated. Avoid late seeding of winter cereals. Do not graze or feed livestock on treated areas for 40 days after planting.
	difenoconazole + metalaxyl-M	Dividend XL RTA	325–650 mL	**Suppression only.** For both commercial seed treatment plants and on-farm treatment using standard gravity flow- or mist-type seed treatment equipment. May also be used in treat-on-the-go seeder. Do not graze, feed green forage or cut for hay within 55 days of planting.

Table 5–3. Chemical Control Options for Diseases in Wheat (continued)

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (Days to harvest, label precautions, etc.)
COMMON BUNT *(Tilletia tritici and Tilletia laevis)*				
Seed Treatment			**per 100 kg seed**	
Cool soil temperatures after seeding favours this disease. This disease was quite important in Ontario wheat production, but the incidence and hence its impact has been reduced substantially due to the effectiveness of fungicide seed treatments. Use seed that is free of bunt spores (black). Infected seed produces a "fishy" smell.	carbathiin + thiram	Vitaflo 280	230–330 mL	Do not graze or feed livestock on treated areas for 6 weeks after planting.
	difenoconazole + metalaxyl-M	Dividend XL RTA	325–650 mL	Controls both seed- and soil-borne common bunt. For both commercial seed treatment plants and on-farm treatment using standard gravity flow- or mist-type seed treatment equipment. May also be used in treat-on-the-go seeder. Do not graze, feed green forage or cut for hay within 55 days of planting.
	tebuconazole + thiram	Raxil T	225 mL	Do not graze or feed livestock on treated areas for 4 weeks after planting.
	triadimenol	Baytan 30	50 mL	Must be diluted with water prior to treatment of seed to ensure uniform coverage. Treated seed will sometimes emerge more slowly than untreated seed. Avoid late seeding of winter cereals. Do not graze or feed livestock on treated areas for 40 days after planting.
	triticonazole + thiram	Gemini	360 mL	For both commercial seed treatment plants and on-farm treatment using standard gravity flow- or mist-type seed treatment equipment. May also be used in treat-on-the-go seeder. Do not use seed for food, feed or oil processing.
FOLIAR, STEM AND HEAD DISEASES (See Appendix G, on page 85, for Zadok's cereal growth stages)				
EARLY-SEASON SEPTORIA *(Septoria* spp.*)*				
Seed Treatment			**per 100 kg seed**	
Early-season septoria control may reduce the risk of later infection. However, if the flag leaf is disease free at the time of head emergence, a fungicide will not likely be necessary. Foliar fungicides will not be necessary.	difenoconazole + metalaxyl-M	Dividend XL RTA	650 mL	**Winter wheat only.** Provides control for the first 6 weeks after planting. For full-season control, apply a foliar fungicide. For both commercial seed treatment plants and on-farm treatment using standard gravity flow- or mist-type seed treatment equipment. May also be used in treat-on-the-go seeder. Do not graze, feed green forage or cut for hay within 55 days of planting.

Table 5–3. Chemical Control Options for Diseases in Wheat (continued)

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (Days to harvest, label precautions, etc.)
SEPTORIA LEAF SPOT *(Septoria tritici)*				
Foliar Treatment			**per ha (per ac)**	
Wet, windy weather and moderate temperatures favour disease development. Destroying volunteer wheat, reducing crop residue and crop rotation also help reduce risk. Use less susceptible varieties. See Appendix G, on page 85, for Zadok's cereal growth stages.	propiconazole	Tilt 250 E	500 mL (200 mL)	Ground and aerial application. Apply at early signs of disease from the beginning of stem elongation (Zadok's 29–37). If conditions favourable to disease continue, another application will be necessary. A second spray may be applied before head is half emerged (Zadok's 49–55). Can be tank-mixed with several cereal herbicides. 45 days to harvest.
		Bumper 418 EC	300 mL (121 mL)	
	mancozeb	Dithane DG Rainshield NT	early: 1.1 kg (440 g) late: 2.25 kg (900 g)	Use lower rate for applications at Zadok's 12–21 growth stage, when crop is in 3rd leaf to tillering. Higher rate for applications at Zadok's 59 growth stage when head is fully emerged but prior to flowering. No more than 2 application/yr. 40 days to harvest. Do not graze crop or cut for hay.
	pyraclostrobin	Headline EC	300–600 mL (120–240 mL)	Ground or aerial. Apply only up to flag leaf fully emerged stage (Zadok's 39). Do not apply at boot stage (Zadok's 47) and beyond. Maximum 2 applications per season. Tank-mixing with insecticide is not recommended, as this fungicide could affect insecticide efficacy.
	tebuconazole	Folicur 432 F	292 mL (118 mL)	Ground or aerial application. **Only one application per year.** Apply only up to flag leaf fully emerged stage (Zadok's 39). Do not apply at boot stage (Zadok's 47) and beyond. Use non-ionic surfactant such as Agral 90 or Agsurf at 0.125% vol/vol. 36 days to harvest. **Before using Folicur for wheat leaf diseases, consider that Folicur can only be applied once per year and has been traditionally used for Fusarium control.**

Table 5–3. Chemical Control Options for Diseases in Wheat (continued)

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (Days to harvest, label precautions, etc.)
POWDERY MILDEW *(Erysiphe graminis f. sp. tritici)*				
Seed Treatment			**per 100 kg seed**	
The fungus is very susceptible to weather conditions that promote drying of the crop environment, such as hot, dry sunny weather. Management includes the use of tolerant varieties, crop rotation, tillage and fungicides. See OMAFRA Publication 811, *Agronomy Guide for Field Crops*, for thresholds and more information.	triadimenol	Baytan 30	50 mL 100 mL	Use higher rate for winter wheat. Must be diluted with water prior to treatment of seed to ensure uniform coverage. Treated seed will sometimes emerge more slowly than untreated seed. Avoid late seeding of winter cereals. Do not graze or feed livestock on treated areas for 40 days after planting.
Foliar Treatment			**per ha (per ac)**	
Foliar fungicide applications may be necessary when disease levels will result in yield losses and a susceptible variety is used. Thresholds for fungicide applications differ depending on the age of the crop. Early-season powdery mildew control is warranted when 5%–10% of the lower leaves are infected, which may limit later infection. Later in the season, powdery mildew symptoms on the flag leaf (1% of leaf) and the second leaf (3%–5% of the leaf) require immediate attention, especially if prolonged wet, humid weather is forecast. See Appendix G, on page 85, for Zadok's cereal growth stages.	propiconazole	Tilt 250 E	500 mL (200 mL)	Ground and aerial application. Apply at early signs of disease from the beginning of stem elongation (Zadok's 29–37). If conditions favourable to disease continue, another application will be necessary. A second spray may be applied before head is half emerged (Zadok's 49–55). Can be tank-mixed with several cereal herbicides. 45 days to harvest.
		Bumper 418 EC	300 mL (121 mL)	
	pyraclostrobin	Headline EC	400–600 mL (160 –240 mL)	Ground or aerial application. Apply only up to flag leaf fully emerged stage (Zadok's 39). Do not apply at boot stage (Zadok's 47) and beyond. Maximum 2 applications per season. 48-hr re-entry period.
	tebuconazole	Folicur 432 F	292 mL (118 mL)	Ground or aerial application. **Only one application per year.** Apply only up to flag leaf fully emerged stage (Zadok's 39). Do not apply at boot stage (Zadok's 47) and beyond. Use non-ionic surfactant such as Agral 90 or Agsurf at 0.125% vol/vol. 36 days to harvest. **Before using Folicur for wheat leaf diseases, consider that Folicur can only be applied once per year and has been traditionally used for Fusarium control.**
	trifloxystrobin + propiconazole	Stratego 250 EC	500 mL (200 mL)	Ground and aerial application. Maximum of 2 applications per year. Do not apply the second application within 14 days of the first. Apply only up to flag leaf fully emerged stage (Zadok's 39). Do not apply at boot stage (Zadok's 47) and beyond. Can be tankmixed with Buctril M in wheat. 45 days to harvest.

Table 5–3. Chemical Control Options for Diseases in Wheat (continued)

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (Days to harvest, label precautions, etc.)
RUST (LEAF — *Puccinia triticina* and STEM — *P. graminis* f. sp. *tritici*)			**per ha (per ac)**	
Leaf rust blows in from the southern United States late in the season. Stem rust has common barberry as an alternate host, therefore removing this alternate host will help minimize stem rust. Use tolerant or resistant varieties. There are many different phenotypes (races), and wheat varieties vary in their resistance/tolerance. The development of new races could result in a once-resistant variety becoming susceptible over time. Use foliar treatments when flag leaf has 5–10 pustules (1% leaf area). See Appendix G, on page 85, for Zadok's cereal growth stages.	propiconazole	Tilt 250 E	500 mL (200 mL)	Ground and aerial application. Apply at early signs of disease from the beginning of stem elongation (Zadok's 29–37). If conditions favourable to disease continue, another application will be necessary. A second spray may be applied before head is half emerged (Zadok's 49–55). Can be tank-mixed with several cereal herbicides. 45 days to harvest.
		Bumper 418 EC	300 mL (121 mL)	
	mancozeb	Dithane DG Rainshield NT	early: 1.1 kg (440 g) late: 2.25 kg (900 g)	**Leaf rust only.** Use lower rate for applications at Zadok's 12–21 growth stage, when crop is in 3rd leaf to tillering. Higher rate for applications at Zadok's 59 growth stage when head is fully emerged but prior to flowering. No more than 2 applications/yr. 40 days to harvest. Do not graze crop or cut for hay.
	pyraclostrobin	Headline EC	300–600 mL (121–240 mL)	**Leaf rust only.** Ground or aerial. Apply only up to flag leaf fully emerged stage (Zadok's 39). Do not apply at boot stage (Zadok's 47) and beyond. Maximum 2 applications per season. 48 hr re-entry period.
	tebuconazole	Folicur 432 F	292 mL (118 mL)	Ground or aerial application. **Only one application per year.** Apply only up to flag leaf fully emerged stage (Zadok's 39). Do not apply at boot stage (Zadok's 47) and beyond. Use non-ionic surfactant such as Agral 90 or Agsurf at 0.125% vol/vol. 36 days to harvest. **Before using Folicur for wheat leaf diseases, consider that Folicur can only be applied once per year and has been traditionally used for Fusarium control.**
	trifloxystrobin + propiconazole	Stratego 250 EC	500 mL (200 mL)	Ground and aerial application. Maximum of 2 applications per year. Do not apply the second application within 14 days of the first. Apply only up to flag leaf fully emerged stage (Zadok's 39). Do not apply at boot stage (Zadok's 47) and beyond. Can be tankmixed with Buctril M in wheat. 45 days to harvest.

Table 5–3. Chemical Control Options for Diseases in Wheat (continued)

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (Days to harvest, label precautions, etc.)
TAN SPOT *(Pyrenophora tritici-repentis)*			**per ha (per ac)**	
Reduced tillage and cool, cloudy, humid weather promote this disease. This disease survives in crop residues. Avoid planting wheat in conservation tillage fields in which wheat was grown during the preceding 2 years. See Appendix G, on page 85, for Zadok's cereal growth stages.	propiconazole	Tilt 250 E	500 mL (200 mL)	Ground and aerial application. Apply at early signs of disease from the beginning of stem elongation (Zadok's 29–37). If conditions favourable to disease continue, another application will be necessary. A second spray may be applied before head is half emerged (Zadok's 49–55). Can be tank-mixed with several cereal herbicides. 45 days to harvest.
		Bumper 418 EC	300 mL (121 mL)	
	mancozeb	Dithane DG Rainshield NT	early: 1.1 kg (440 g) late: 2.25 kg (900 g)	Use lower rate for applications at Zadok's 12–21 growth stage, when crop is in 3rd leaf to tillering. Higher rate for applications at Zadok's 59 growth stage when head is fully emerged but prior to flowering. No more than 2 applications/yr. 40 days to harvest. Do not graze crop or cut for hay.
	pyraclostrobin	Headline EC	300–600 mL (121–240 mL)	Ground or aerial. Apply only up to flag leaf fully emerged stage (Zadok's 39). Do not apply at boot stage (Zadok's 47) and beyond. Maximum 2 applications per season. 48 hr re-entry period.
	tebuconazole	Folicur 432 F	292 mL (118 mL)	Ground or aerial application. **Only one application per year.** Apply only up to flag leaf fully emerged stage (Zadok's 39). Do not apply at boot stage (Zadok's 47) and beyond. Use non-ionic surfactant such as Agral 90 or Agsurf at 0.125% vol/vol. 36 days to harvest. **Before using Folicur for wheat leaf diseases, consider that Folicur can only be applied once per year and has been traditionally used for Fusarium control.**
	trifloxystrobin + propiconazole	Stratego 250 EC	500 mL (200 mL)	Ground and aerial application. Maximum of 2 applications per year. Do not apply the second application within 14 days of the first. Apply only up to flag leaf fully emerged stage (Zadok's 39). Do not apply at boot stage (Zadok's 47) and beyond. Can be tankmixed with Buctril M in wheat. 45 days to harvest.
FUSARIUM HEAD BLIGHT *(Fusarium graminearum)*				
Warm and prolonged wet conditions during flowering are necessary for infection to occur. Avoid planting into corn stubble, since the fungus also causes Gibberella stalk rot in corn. Wheat should follow soybeans in the rotation. See Fusarium forecasting web page at www.ownweb.ca to determine the Fusarium head blight risk for your area and for current recommendations. Consult your local crop advisor for forecast information. See Appendix G, on page 85, for Zadok's cereal growth stages.	tebuconazole	Folicur 432 F	292 mL (118 mL)	**Suppression only.** Ground or aerial application. **Maximum of one application per year.** Timing of application is critical. The optimum window for application is 1 to 4 days after 75% of the heads have emerged or cleared the head (Day 0). Ensure thorough coverage of all wheat heads. Recommended to be used with the registered non-ionic surfactant, Agral 90 or AgSurf at 0.125% vol/vol. Maximum of 1 application per season. Do not allow livestock to graze or feed green forage to livestock prior to 6 days after treatment. Do not enter treated fields for 12 hours after application. 36 days to harvest.

Table 5–3. Chemical Control Options for Diseases in Wheat (continued)

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (Days to harvest, label precautions, etc.)
STAGONOSPORA GLUME BLOTCH *(Stagonospora nodorum)*			**per ha (per ac)**	
Prolonged wet periods in May and early June result in increased disease incidence. Rotation with crops other than cereals, plowing down of cereal residues and removal of volunteer wheat reduces survivability of the fungi. See Appendix G, on page 85, for Zadok's cereal growth stages.	chlorothalonil	Bravo 500	1.5–2.5 mL (0.6–1.0 L)	Apply at Zadok's growth stage 37 (flag leaf emergence) and repeat 10–14 days later at growth stage 51–55 (visible ear). A 3rd application at growth stage 59–69 (ear fully emerged) may be necessary if conditions favour disease spread. Maximum 3 applications/yr. 30 days to harvest.
	propiconazole	Tilt 250 E	500 mL (200 mL)	Ground and aerial application. Apply at early signs of disease from the beginning of stem elongation (Zadok's 29–37). If conditions favourable to disease continue, another application will be necessary. A second spray may be applied before head is half emerged (Zadok's 49–55). Can be tank-mixed with several cereal herbicides. 45 days to harvest.
		Bumper 418 EC	300 mL (121 mL)	
STRIPE RUST *(Puccinia striiformis)*			**per ha (per ac)**	
Can be confused with Cephalosporium stripe since both will produce a yellow striping (interveinal) that can extend the entire length of the leaf. If rust is the cause, orange-yellow pustules (blisters) can be found, whereas no blistering is found in Cephalosporium stripe. Most noticeable in seasons with a prolonged cool spring (3°C–15°C). Symptoms often disappear as temperatures increase.	pyraclostrobin	Headline EC	400–600 mL (160–240 mL)	Ground or aerial. Apply only up to flag leaf fully emerged stage (Zadok's 39). Do not apply at boot stage (Zadoks 47) and beyond. Maximum 2 applications per season. 48-hr re-entry period.
	propiconazole	Tilt 250 E	500 mL (200 mL)	Ground and aerial application. Apply at early signs of disease from the beginning of stem elongation (Zadok's 29–37). If conditions favourable to disease continue, another application will be necessary. A second spray may be applied before head is half emerged (Zadok's 49–55). Can be tank-mixed with several cereal herbicides. 45 days to harvest.
		Bumper 418 EC	300 mL (121 mL)	
	tebuconazole	Folicur 432 F	292 mL (118 mL)	Ground or aerial application. **Only one application per year.** Apply only up to flag leaf fully emerged stage (Zadok's 39). Do not apply at boot stage (Zadok's 47) and beyond. Use non-ionic surfactant such as Agral 90 or Agsurf at 0.125% vol/vol. 36 days to harvest. **Before using Folicur for wheat leaf diseases, consider that Folicur can only be applied once per year and has been traditionally used for Fusarium control.**
	trifloxystrobin + propiconazole	Stratego 250 EC	500 mL (200 mL)	Ground and aerial application. Maximum of 2 applications per year. Do not apply the second application within 14 days of the first. Apply only up to flag leaf fully emerged stage (Zadok's 39). Do not apply at boot stage (Zadok's 47) and beyond. Can be tankmixed with Buctril M in wheat. 45 days to harvest.

Table 5–4. Barley Seed and Soil-Applied Fungicide Recommendations

Active Ingredient	Products	Formulation	Barley Diseases		
			Seed and Seedling Blight	Covered Smut	True Loose Smut
carbathiin + thiram	Vitaflo 280	F	+	+	+
difenoconazole + metalaxyl -M	Dividend XL RTA	F	+	+	+
tebuconazole + thiram	Raxil T	F	+	+	+
triadimenol	Baytan 30	F	—	+	+
triticonazole + thiram	Gemini	F	+	+	+

DB = Drill Box Application **EC = Emulsifiable Concentrate** **F = Flowable** **P = Powder**

+ = Recommended for disease listed **— = Not Recommended**

Table 5–5. Oats Seed and Soil-Applied Fungicide Recommendations

Active Ingredient	Products	Formulation	Oat Diseases			
			Seedling Blight	Covered Smut	True Loose Smut	Pythium
carbathiin + thiram	Vitaflo 280	F	+	+	+	+
difenoconazole + metalaxyl -M	Dividend XL RTA	F	+	+	+	+
tebuconazole + thiram	Raxil T	F	—	+	+	—
triticonazole + thiram	Gemini	F	—	+	+	—

DB = Drill Box Application **EC = Emulsifiable Concentrate** **F = Flowable** **P = Powder**

+ = Recommended for disease listed **— = Not Recommended**

Table 5–6. Rye Seed and Soil-Applied Fungicide Recommendations

Active Ingredient	Products	Formulation	Rye Diseases				
			Seedling Blight	Seed-Borne Septoria	Common Bunt	Dwarf Bunt	Pythium Damping-Off
carbathiin + thiram	Vitaflo 280	F	+	—	—	—	+
difenoconazole + metalaxyl -M	Dividend XL RTA	F	+	+	+	+	+

DB = Drill Box Application **EC = Emulsifiable Concentrate** **F = Flowable** **P = Powder**

+ = Recommended for disease listed **— = Not Recommended**

Table 5–7. Chemical Control Options for Diseases in Barley, Oats and Rye

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (Days to harvest, label precautions, etc.)
BARLEY				
SEED AND SEEDLING DISEASES				
SEED ROT AND SEEDLING BLIGHT				
Seed Treatment			**per 100 kg seed**	
Ensure good coverage of seed treatment on seeds. Rotation with non-host crops for at least 2 yr will reduce risk. Use disease-free seed and avoid deep seeding.	tebuconazole + thiram	Raxil T	225 mL	Do not graze or feed livestock on treated areas for 4 weeks after planting.
	carbathiin + thiram	Vitaflo 280	230–330 mL	Do not graze or feed livestock on treated areas for 6 weeks after planting.
	triticonazole + thiram	Gemini	360 mL	For both commercial seed treatment plants and on-farm treatment using standard gravity flow- or mist-type seed treatment equipment. May also be used in treat-on-the-go seeder. Do not use seed for food, feed or oil processing.
COCHLIOBOLUS SEEDLING BLIGHT *(Cochliobolus sativus)*				
Seed Treatment			**per 100 kg seed**	
Avoid continuous or overuse of barley. Avoid deep seeding. Turn under stubble to help reduce infection levels. Use resistant varieties.	tebuconazole + thiram	Raxil T	225 mL	Do not graze or feed livestock on treated areas for 4 weeks after planting.
COVERED SMUT (COMMON BUNT) *(Ustilago hordei)*				
Seed Treatment			**per 100 kg seed**	
Infection can occur at temperatures of 14°C–25°C (57°F– 68°F), especially when the soil moisture levels are high. Seed treatment is the primarily method of control.	tebuconazole + thiram	Raxil T	225 mL	Do not graze or feed livestock on treated areas for 4 weeks after planting.
	triadimenol	Baytan 30	50 mL	**Spring Barley.** Must be diluted with water prior to treatment of seed to ensure uniform coverage. Treated seed will sometimes emerge more slowly than untreated seed. Avoid late seeding of winter cereals. Do not graze or feed livestock on treated areas for 40 days after planting.
	carbathiin + thiram	Vitaflo 280	230–330 mL	Do not graze or feed livestock on treated areas for 6 weeks after planting.
	triticonazole + thiram	Gemini	360 mL	For both commercial seed treatment plants and on-farm treatment using standard gravity flow- or mist-type seed treatment equipment. May also be used in treat-on-the-go seeder. Do not use seed for food, feed or oil processing.
LOOSE SMUT *(Ustilago nuda)*				
Seed Treatment			**per 100 kg seed**	
Infection occurs during flowering. Conditions that promote the disease are wet, cloudy weather and moderate temperatures 16°C–22°C (60°F–72°F). Sow pedigree seed. Moist weather at flowering promotes this disease. Use seed treatment on seed known to have high levels of infection.	tebuconazole + thiram	Raxil T	225 mL	Do not graze or feed livestock on treated areas for 4 weeks after planting.
	triadimenol	Baytan 30	50 mL	Must be diluted with water prior to treatment of seed to ensure uniform coverage. Treated seed will sometimes emerge more slowly than untreated seed. Avoid late seeding of winter cereals. Do not graze or feed livestock on treated areas for 40 days after planting.
	carbathiin + thiram	Vitaflo 280	230–330 mL	Do not graze or feed livestock on treated areas for 6 weeks after planting.
	triticonazole + thiram	Gemini	360 mL	For both commercial seed treatment plants and on-farm treatment using standard gravity flow- or mist-type seed treatment equipment. May also be used in treat-on-the-go seeder. Do not use seed for food, feed or oil processing.

Table 5–7. Chemical Control Options for Diseases in Barley, Oats and Rye (continued)

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (Days to harvest, label precautions, etc.)
FOLIAR, STEM AND HEAD DISEASES				
NET BLOTCH *(Pyrenophora teres)*			**per ha (per ac)**	
Avoid growing barley after barley, wheat or grasses. Plow-down stubble and straw and plant early to avoid serious disease in July.	propiconazole	Tilt 250 E	500 mL (200 mL)	Ground and aerial application. Apply at early signs of disease from tillering to head half emerged. Can be tank-mixed with several cereal herbicides. 45 days to harvest.
		Bumper 418 EC	300 mL (121 mL)	
	pyraclostrobin	Headline EC	300–600 mL (121–240 mL)	Ground or aerial. Apply only up to flag leaf fully emerged stage (Zadok's 39). Do not apply at boot stage (Zadok's 47) and beyond. Maximum 2 applications per season. Tank-mixing with insecticide is not recommended, as this fungicide could affect insecticide efficacy.
	trifloxystrobin + propiconazole	Stratego 250 EC	500 mL (200 mL)	**Spring barley.** Ground and aerial application. Maximum of 2 applications per year. Do not apply the second application within 14 days of the first. Apply only up to flag leaf fully emerged stage (Zadok's 39). Do not apply at boot stage (Zadok's 47) and beyond. 45 days to harvest.
SPOT BLOTCH *(Cochliobolus sativus)*			**per ha (per ac)**	
Avoid growing barley after barley, wheat or grasses. Plow-down stubble and straw and plant early to avoid serious disease in July.	propiconazole	Tilt 250 E	500 mL (200 mL)	Ground and aerial application. Apply at early signs of disease from tillering to head half emerged. Can be tank-mixed with several cereal herbicides. 45 days to harvest.
		Bumper 418 EC	300 mL (121 mL)	
	pyraclostrobin	Headline EC	400–600 mL (160–240 mL)	Ground or aerial. Apply only up to flag leaf fully emerged stage (Zadok's 39). Do not apply at boot stage (Zadok's 47) and beyond. Maximum 2 applications per season. Tank-mixing with insecticide is not recommended, as this fungicide could affect insecticide efficacy.
	trifloxystrobin + propiconazole	Stratego 250 EC	500 mL (200 mL)	**Spring barley.** Ground and aerial application. Maximum of 2 applications per year. Do not apply the second application within 14 days of the first. Apply only up to flag leaf fully emerged stage (Zadok's 39). Do not apply at boot stage (Zadok's 47) and beyond. 45 days to harvest.
SCALD *(Rhynchosporium secalis)*			**per ha (per ac)**	
Avoid growing barley after barley, wheat or grasses. Plow-down stubble and straw and plant early to avoid serious disease in July.	propiconazole	Tilt 250 E	500 mL (200 mL)	Ground and aerial application. Apply at early signs of disease from tillering to head half emerged. Can be tank-mixed with several cereal herbicides. 45 days to harvest.
		Bumper 418 EC	300 mL (121 mL)	
	pyraclostrobin	Headline EC	400–600 mL (160–240 mL)	Ground or aerial. Apply only up to flag leaf fully emerged stage (Zadok's 39). Do not apply at boot stage (Zadok's 47) and beyond. Maximum 2 applications per season. Tank-mixing with insecticide is not recommended, as this fungicide could affect insecticide efficacy.
	trifloxystrobin + propiconazole	Stratego 250 EC	500 mL (200 mL)	**Spring barley.** Ground and aerial application. Maximum of 2 applications per year. Do not apply the second application within 14 days of the first. Apply only up to flag leaf fully emerged stage (Zadok's 39). Do not apply at boot stage (Zadok's 47) and beyond. 45 days to harvest.
SEPTORIA LEAF SPOT *(Septoria tritici)*			**per ha (per ac)**	
Avoid growing barley after barley, wheat or grasses. Plow-down stubble and straw and plant early to avoid serious disease in July.	propiconazole	Tilt 250 E	500 mL (200 mL)	Ground and aerial application. Apply at early signs of disease from tillering to head half emerged. Can be tank-mixed with several cereal herbicides. 45 days to harvest.
		Bumper 418 EC	300 mL (121 mL)	
	trifloxystrobin + propiconazole	Stratego 250 EC	500 mL (200 mL)	**Spring barley.** Ground and aerial application. Maximum of 2 applications per year. Do not apply the second application within 14 days of the first. Apply only up to flag leaf fully emerged stage (Zadok's 39). Do not apply at boot stage (Zadok's 47) and beyond. 45 days to harvest.

Table 5–7. Chemical Control Options for Diseases in Barley, Oats and Rye (continued)

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (Days to harvest, label precautions, etc.)
RUST (LEAF —*Puccinia hordei*, STEM — *Puccinia graminis* f. sp. *tritici*)			**per ha (per ac)**	
Leaf rust spores are blown in from the U.S. and in most years late planted fields are most likely to show the disease. Alternate host is barberry. Remove or destroy alternate host from fence rows, etc. Plant early.	propiconazole	Tilt 250 E	500 mL (200 mL)	Ground and aerial application. Apply at early signs of disease from tillering to head half emerged. Can be tank-mixed with several cereal herbicides. 45 days to harvest.
		Bumper 418 EC	300 mL (121 mL)	
OATS				
SEED AND SEEDLING DISEASES				
SEED ROT AND SEEDLING BLIGHT (*Pyrenopora avenae*, *Fusarium* spp. and others)				
Seed Treatment			**per 100 kg seed**	
Ensure good coverage of seed treatment on seeds. Rotation with non-host crops for at least 2 years will reduce risk. Use disease-free seed and avoid deep seeding.	carbathiin + thiram	Vitaflo 280	330 mL	Do not graze or feed livestock on treated areas for 6 weeks after planting.
	difenoconazole + metalaxyl-M	Dividend XL RTA	325–650 mL	For both commercial seed treatment plants and on-farm treatment using standard gravity flow- or mist-type seed treatment equipment. May also be used in treat-on-the-go seeder. Do not graze, feed green forage or cut for hay within 35 days of planting.
COVERED SMUT (COMMON BUNT) (*Ustilago kolleri*), LOOSE SMUT (*Ustilago avenae*)				
Seed Treatment			**per 100 kg seed**	
Spread from year to year primarily through infected seed. Wind-blown spores will infect florets within season. Use a fungicide seed treatment on infected seed.	carbathiin + thiram	Vitaflo 280	330 mL	Do not graze or feed livestock on treated areas for 6 weeks after planting.
	difenoconazole + metalaxyl-M	Dividend XL RTA	325–650 mL	For both commercial seed treatment plants and on-farm treatment using standard gravity flow- or mist-type seed treatment equipment. May also be used in treat-on-the-go seeder. Do not graze, feed green forage or cut for hay within 35 days of planting.
	triticonazole + thiram	Gemini	360 mL	For both commercial seed treatment plants and on-farm treatment using standard gravity flow or mist type seed treatment equipment. May also be used in treat-on-the-go seeder. Do not use seed for food, feed or oil processing.
	tebuconazole + thiram	Raxil T	225 mL	**For loose smut control only.** Do not graze or feed livestock on treated areas for 4 weeks after planting.
PYTHIUM DAMPING OFF (*Pythium* spp.)			**per ha (per ac)**	
Can occur on all soil types but losses are greatest in cold, wet, clay soils. Minimize soil compaction and remove excess moisture through increased drainage. Seed treatments containing metalaxyl –M can reduce infection. Delay planting until conditions will result in a rapid and uniform emergence.	carbathiin + thiram	Vitaflo 280	330 mL	Do not graze or feed livestock on treated areas for 6 weeks after planting.
	difenoconazole + metalaxyl-M	Dividend XL RTA	325–650 mL	For both commercial seed treatment plants and on-farm treatment using standard gravity flow- or mist-type seed treatment equipment. May also be used in treat-on-the-go seeder. Do not graze, feed green forage or cut for hay within 35 days of planting.
	tebuconazole + thiram	Raxil T	225 mL	Do not graze or feed livestock on treated areas for 4 weeks after planting.

Table 5–7. Chemical Control Options for Diseases in Barley, Oats and Rye (continued)

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (Days to harvest, label precautions, etc.)
LEAF, STEM AND HEAD DISEASES				
SEPTORIA LEAF SPOT *(Septoria tritici)*			**per ha (per ac)**	
Avoid planting oats after oats or mixed grain. Humid, wet, windy weather promotes disease.	propiconazole	Tilt 250 E	500 mL (200 mL)	Ground and aerial application. Apply at early signs of disease from tillering to head half emerged. 45 days to harvest.
		Bumper 418 EC	300 mL (121 mL)	Ground and aerial application. Apply at early signs of disease from tillering to head half emerged. Can be tank mixed with several cereal herbicides. 45 days to harvest.
	trifloxystrobin + propiconazole	Stratego 250 EC	500 mL (200 mL)	Ground and aerial application. Maximum of 2 applications per year. Do not apply the second application within 14 days of the first. Apply only up to flag leaf fully emerged stage (Zadok's 39). Do not apply at boot stage (Zadok's 47) and beyond. 45 days to harvest.
CROWN (LEAF) RUST *(Puccinia coronata* var. *avenae)*			**per ha (per ac)**	
European buckthorn is the alternate host. Can be a problem in central and Eastern Ontario. Use resistant varieties. Plant early to allow plants to mature before inoculum levels become heavy. Remove or destroy buckthorn.	propiconazole	Tilt 250 E	500 mL (200 mL)	Ground and aerial application. Apply at early signs of disease from tillering to head half emerged. 45 days to harvest.
		Bumper 418 EC	300 mL (121 mL)	Ground and aerial application. Apply at early signs of disease from tillering to head half emerged. Can be tank mixed with several cereal herbicides. 45 days to harvest.
	trifloxystrobin + propiconazole	Stratego 250 EC	500 mL (200 mL)	Ground and aerial application. Maximum of 2 applications per year. Do not apply the second application within 14 days of the first. Apply only up to flag leaf fully emerged stage (Zadok's 39). Do not apply at boot stage (Zadok's 47) and beyond. 45 days to harvest.
RYE				
SEEDLING BLIGHT *(Pythium* spp., *Rhizoctonia* spp., *Fusarium* spp.)				
Seed Treatment			**per 100 kg seed**	
Sow into a well-prepared seed bed under good growing conditions. Avoid cool, wet conditions that will reduce emergence and increase seed rots and blights. Treat seed with a fungicide seed treatment.	carbathiin + thiram	Vitaflo 280	230–330 mL	Do not graze or feed livestock on treated areas for 4 weeks after planting.
	difenoconazole + metalaxyl-M	Dividend XL RTA	325–650 mL	For both commercial seed treatment plants and on-farm treatment using standard gravity flow- or mist-type seed treatment equipment. May also be used in treat-on-the-go seeder. Do not graze, feed green forage or cut for hay within 35 days of planting.
PYTHIUM DAMPING-OFF *(Pythium* spp.)				
Seed Treatment			**per 100 kg seed**	
Sow into a well-prepared seed bed under good growing conditions. Avoid cool, wet conditions that will reduce emergence and increase seed rots and blights. Treat seed with a fungicide seed treatment.	carbathiin + thiram	Vitaflo 280	230–330 mL	Do not graze or feed livestock on treated areas for 4 weeks after planting.
	difenoconazole + metalaxyl-M	Dividend XL RTA	325–650 mL	For both commercial seed treatment plants and on-farm treatment using standard gravity flow- or mist-type seed treatment equipment. May also be used in treat-on-the-go seeder. Do not graze, feed green forage or cut for hay within 35 days of planting.
SEED-BORNE SEPTORIA *(Septoria* spp.)				
Seed Treatment			**per 100 kg seed**	
Sow into a well-prepared seed bed under good growing conditions. Avoid cool, wet conditions that will reduce emergence and increase seed rots and blights. Treat seed with a fungicide seed treatment.	difenoconazole + metalaxyl-M	Dividend XL RTA	325–650 mL	For both commercial seed treatment plants and on-farm treatment using standard gravity flow- or mist-type seed treatment equipment. May also be used in treat-on-the-go seeder. Do not graze, feed green forage or cut for hay within 35 days of planting.

Table 5–7. Chemical Control Options for Diseases in Barley, Oats and Rye (continued)

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (Days to harvest, label precautions, etc.)
COMMON BUNT *(Tilletia caries)*, DWARF BUNT *(Tilletia controversa)*				
Seed Treatment			**per 100 kg seed**	
Sow into a well-prepared seed bed under good growing conditions. Avoid cool, wet conditions that will reduce emergence and increase seed rots and blights. Treat seed with a fungicide seed treatment.	difenoconazole + metalaxyl-M	Dividend XL RTA	325–650 mL	For both commercial seed treatment plants and on-farm treatment using standard gravity flow- or mist-type seed treatment equipment. May also be used in treat-on-the-go seeder. Do not graze, feed green forage or cut for hay within 35 days of planting.
LEAF RUST *(Puccinia recondita* f. sp. *recondita)*				
Foliar Treatment			**per ha (per ac)**	
Leaf rust in rye is caused by the same fungus that infects wheat. Refer to leaf rust in wheat for management options and details.	pyraclostrobin	Headline EC	300–600 mL (120–240 mL)	Ground or aerial. Apply only up to flag leaf fully emerged stage (Zadok's 39). Do not apply at boot stage (Zadok's 47) and beyond. Maximum 2 applications per season. Tank-mixing with insecticide is not recommended, as this fungicide could affect insecticide efficacy.
POWDERY MILDEW *(Erysiphe graminis* f. sp. *secalis)*			**per ha (per ac)**	
In most cases, powdery mildew has little impact on rye since the crop is very resistant to the disease.	pyraclostrobin	Headline EC	400–600 mL (160–240 mL)	Ground or aerial. Apply only up to flag leaf fully emerged stage (Zadok's 39). Do not apply at boot stage (Zadok's 47) and beyond. Maximum 2 applications per season. Tank-mixing with insecticide is not recommended, as this fungicide could affect insecticide efficacy.

6. Dry Edible Beans

INSECTS

Table 6–1. Chemical Control Options for Insects in Dry Edible Beans

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (Days to harvest, label precautions, etc.)
SEEDCORN MAGGOT *(Delia platura)*				
Seed Treatment			**per 100 kg seed**	
Seedcorn maggot problems are rare in Ontario. Risk factors include cool, wet springs when germination is delayed. Fields at high risk, including early-planted fields where large amounts of manure, green manure or residue have recently been incorporated, should use Cruiser seed treatment.	thiamethoxam	Cruiser 350 FS	86–143 mL	For use in commercial seed treaters only. Use higher rate when insect populations are expected to be high. May be mixed with Apron Max RTA for control of seed and soil-borne pathogens. Do not graze or feed livestock on treated areas for 45 days after planting.
			per ha (per ac)	
	diazinon + captan + thiophanate-methyl	DCT	1 L of slurry	Available in a 400-g container that will treat 77 kg of dry bean seed. Use full rate and ensure good coverage by applying as a slurry. To make slurry, use 520 g seed treatment/L of water.
MEXICAN BEAN BEETLE *(Epilachna varivestis)*			**per ha (per ac)**	
Less of a problem in very hot, dry summers. Early maturing bean varieties and fall plantings may be grown with little or no injury. Several natural enemies help keep populations below action thresholds. Insecticides are only recommended if populations are extremely high, as they will also kill the natural enemy population.	dimethoate	Cygon 4 E	0.7–1.0 L (280–400 mL)	Do not feed treated threshings or crop refuse to livestock. 7 days to harvest.
		Lagon 480 EC	0.7–1.0 L (280–400 mL)	
	endosulfan	Thiodan 4 EC	1.5–2.5 L (0.6–1.0 L)	Do not feed treated threshings or crop refuse to livestock. 2 days to harvest.
		Thionex EC	1.5–2.5 L (0.6–1.0 L)	Do not use on lima beans.
		Thionex 50 WP	1.1–1.5 kg (400–600 g)	

Table 6–1. Chemical Control Options for Insects in Dry Edible Beans (continued)

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (Days to harvest, label precautions, etc.)
POTATO LEAFHOPPER *(Empoasca fabae)*			**per ha (per ac)**	
Soil Applied at Planting Only				
	phorate	Thimet 15 G	7.25–11 kg (2.9–4.4 kg)	Lock and load. Must be applied in a 10–15-cm band over the row behind the planter shoe, in front of the press wheel. Do not place in direct contact with seed. Do not feed the foliage of treated beans within 60 days.
Seed Treatments			**per 100 kg seed**	
Consider using insecticide seed treatment on fields with a history of leafhopper infestations, to reduce the number of foliar applications required. Research has shown insecticide seed treatment to last at least 4–6 weeks after planting, eliminating the need for at least one foliar insecticide application.	thiamethoxam	Cruiser 350 FS	86–143 mL	For use in commercial seed treaters only. Use higher rate when insect populations are expected to be high. Do not graze or feed livestock on treated areas for 45 days after planting.
Foliar Treatment			**per ha (per ac)**	
Some tolerant varieties available. See OMAFRA Publication 811, *Agronomy Guide for Field Crops*, for action threshold charts and sampling methods.	dimethoate	Cygon 4 E	0.7–1.0 L (280–400 mL)	Residual activity expected from this product.
		Lagon 480 EC	0.7–1.0 L (280–400 mL)	Do not feed treated threshings or crop refuse to livestock. 7 days to harvest.
	endosulfan	Thiodan 4 EC	1.5–2.5 L (0.6–1.0 L)	Do not feed treated threshings or crop refuse to livestock. 2 days to harvest.
		Thionex EC	1.5–2.5 L (0.6–1.0 L)	Do not use on Lima beans.
		Thionex 50 WP	1.1–1.5 kg (400–600 g)	
	cyhalothrin-lambda	Matador 120 E	83 mL (34 mL)	**Has no systemic activity.** Ground application only. For best results, apply during the early morning, before temperatures rise, and during the evening, past the heat of the day. Use 100–200 L of water/ha. Maximum of 3 applications/yr. 14 days to harvest. Do not re-enter treated areas until 24 hr of treatment. Do not graze or feed on treated forage.
TARNISHED PLANT BUG *(Lygus lineolaris)* and LYGUS spp.			**per ha (per ac)**	
Lygus can sting the developing pods, resulting in damaged seeds. Beans should be monitored during the early pod-filling stages. A treatment may be required when there are 1–2 bugs per sweep later in the season.	dimethoate	Cygon 4 E	0.7–1 L (280–400 mL)	Do not feed or allow livestock to graze treated plant material. No more than 3 applications per season. 7 days to harvest.
		Lagon 480 E	0.7–1 L (280–400 mL)	
	cyhalothrin-lambda	Matador 120 E	83 mL (34 mL)	**Has no systemic activity.** Ground application only. For best results, apply during the early morning, before temperatures rise, and during the evening, past the heat of the day. Use 100–200 L water/ha. Maximum of 3 applications/yr. 14 days to harvest. Do not re-enter treated areas until 24 hr of treatment. Do not graze or harvest treated forage, straw or hay for livestock feed.
GREEN CLOVERWORM *(Hypena scabra)*			**per ha (per ac)**	
Several natural enemies help to keep populations below action thresholds. Insecticides are only recommended if populations are extremely high, as they will also kill the natural enemy population.	endosulfan	Thiodan 4 EC	1.5–2.5 L (0.6–1.0 L)	Do not apply on lima beans. Do not feed treated threshings or crop refuse to livestock. 2 days to harvest.

Table 6–2. Edible Bean Seed and Soil-Applied Fungicide Recommendations

Active Ingredients	Product	Formulation	Dry Edible Bean Diseases			
			Anthracnose	Pythium Damping-Off	Fusarium Seedling Blight	Rhizoctonia
Insect and Disease Control						
Untreated Seed						
diazinon + captan	Agrox B-2	P (DB)	—	—	+	—
diazinon + captan + thiophanate-methyl	DCT[1]	P	+	—	+	+
Seed Pretreated With Fungicide						
diazinon + captan	Agrox CD		**For insect control only. Disease control via fungicide pretreatment.**			
Disease Control						
carbathiin + thiram	Vitaflo 280	LS	—	—	+	+
fludioxonil + metalaxyl-M	Apron Maxx RTA	F	—	+	+	+
metalaxyl	Apron FL	F	—	+	—	—
metalaxyl – M	Apron XL	LS	—	+	—	—

DB = Drill Box Application **EC = Emulsifiable Concentrate** **F = Flowable** **P = Powder** **LS = Liquid Suspension**

+ = Recommended for disease listed **— = Not Recommended**

[1] Due to anthracnose, all edible beans MUST be treated with DCT.

Table 6–3. Chemical Control Options for Diseases in Dry Edible Beans

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (Days to harvest, label precautions, etc.)
SEED AND SEEDLING DISEASES				
Seedling Diseases			**per 100 kg seed**	
Present in all fields and all soil types. Maintain or build up good soil tilth by following a good crop rotation (3 years between bean crops of any kind), don't overwork the soil and avoiding working it when it is too wet. Apply seed treatments that will help protect the plant from root rots during germination and early growth. Use tolerant varieties.	diazinon + captan + thiophanate-methyl	DCT	1 L of slurry	Due to anthracnose, all edible beans **MUST** be treated with DCT. Seedling blights and damping-off are also controlled. Use full rate and ensure good coverage by applying as a slurry. Available as 400-g container that will treat 77 kg of dry bean seed. To make slurry, use 520 g seed treatment/L of water. For control of Pythium and Phytophthora root rots, add metalaxyl.
PYTHIUM DAMPING-OFF *(Pythium* spp.)			**per 100 kg seed**	
Can occur on all soil types but losses are greatest on wet, clay soils. Minimize soil compaction and remove excess moisture through increased drainage. Seed should be treated with metalaxyl or metalaxyl-M and planted into warm soils 16°C (60°F). Rotate 3–4 yr between bean crops. **Due to anthracnose concerns, all seed should be treated with DCT. See the section on *Anthracnose (Colletotrichum lindemuthianum)*, on page 65, for more details.**	metalaxyl-M	Apron XL LS	20–40 mL	Do not use in hopper-box, planter-box, slurry-box or other non-commercial seed treatment applications at or immediately before planting. Do not graze or feed livestock on seeded area for 4 weeks after planting. Read label for information regarding resistant strains of fungus.
	metalaxyl	Allegiance FL	46–110 mL	Do not graze or feed livestock on seeded area for 4 weeks after planting.
		Apron FL	46–110 mL	
	fludioxonil + metalaxyl-M	Apron Maxx RTA	325 mL	For both commercial seed treatment plants and on-farm treatment using standard gravity- or mist-type seed treatment equipment. Compatible with Rhizobium-based inoculants. Check with inoculant manufacturers prior to use. Ensure uniform coverage.
FUSARIUM SEED AND ROOT ROT *(Fusarium solani* f. sp. *phaseoli)*				
Seed Treatment			**per 100 kg seed**	
Fusarium begins as small, reddish-brown lesions on the taproot that join to form larger lesions, or streaks, as the plant ages. The lesion can extend up to the soil line. Splitting of the tap root, crown and lower stem often reveals a brown-reddish internal discoloration of the water-conducting tissue. Longitudinal cracks and adventitious roots may develop on damaged plants. These adventitious roots are formed above the damaged area. Late infection seldom results in dead plants but rather in stunted, unthrifty-looking ones. Disease development is promoted by soil compaction, short crop rotations and moisture stress. **Due to anthracnose concerns, all seed should be treated with DCT. See the section on *Anthracnose (Colletotrichum lindemuthianum)*, on page 65, for more details.**	diazinon + captan + thiophanate-methyl	DCT	1 L of slurry	Due to anthracnose, all edible beans **MUST** be treated with DCT. Seedling blights and damping-off are also controlled. Use full rate and ensure good coverage by applying as a slurry. Available ina 400-g container that will treat 77 kg of dry bean seed. To make slurry, use 520 g seed treatment/L of water. For control of Pythium and Phytophthora root rots, add metalaxyl.
	carbathiin + thiram	Vitaflo 280	260 mL	Ensure good seed coverage.
	fludioxonil + metalaxyl-m	Apron Maxx RTA	325 mL	For both commercial seed treatment plants and on-farm treatment using standard gravity- or mist-type seed treatment equipment. Compatible with *Rhizobium*-based inoculants. Check with inoculant manufacturers prior to use. Ensure uniform coverage.
	diazinon + captan	Agrox B-2	320 mL	Available in a 2-kg container that will treat 625 kg of bean seed. Use full rate and ensure good coverage of seed. Seed within 1 month of treatment. Do not use on seed already treated with an insecticide.

Table 6–3. Chemical Control Options for Diseases in Dry Edible Beans (continued)

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (Days to harvest, label precautions, etc.)
ANTHRACNOSE *(Colletotrichum lindemuthianum)*				
Seed Treatment			**per 100 kg seed**	
Anthracnose is best controlled by planting disease-free seed and using a seed treatment containing DCT. Should disease still appear, a foliar fungicide can be used as a rescue treatment.	diazinon + captan + thiophanate-methyl	DCT	1 L of slurry	Due to anthracnose, all edible beans **MUST** be treated with DCT. Available ina 400-g container that will treat 77 kg of dry bean seed. To make slurry, use 520 g seed treatment/L of water. Use full rate and ensure good coverage by applying as a slurry. For control of Pythium and Phytophthora root rots, add metalaxyl.
Foliar Treatment			**per ha (per ac)**	
Rainy weather favours this disease, as spores are splashed from diseased areas and carried in wind-borne water droplets or by surface water throughout the field. Wet conditions over a prolonged period of time can result in epidemics, therefore take note of weather forecasts. Timing of foliar fungicides is important.	azoxystrobin	Quadris	500 mL (200 mL)	Ground or aerial application. Apply 1st application at early flower or when disease first appears. If necessary, re-apply 10–14 days later if disease persists. Maximum of 2 applications per season. 15 days to harvest.
	pyraclostrobin	Headline EC	400 mL (160 mL)	Ground or aerial application. Apply when disease first appears. If necessary, re-apply 10–14 days later if disease persists. Tank-mixing with insecticide is not recommended, as this fungicide could affect insecticide efficacy. Tank-mixing with Lance is not recommended, as precipitates can develop. To minimize risk of precipitates forming, use water >10°C and spray solution promptly. Maximum of 2 applications per season. 30 days to harvest.
RHIZOCTONIA *(Rhizoctonia solani)*			**per 100 kg seed**	
Problem when conditions are cool and wet during planting or when these conditions result in a delay in seedling emergence or development. Mid- to-late-season moisture stress (dry conditions) can increase the disease. Management practices include: (1) Selecting varieties with good general tolerance to root rots, (2) promoting root growth through a good fertility program, (3) rotating crop (3 yr between bean crops), (4) not overworking the soil and avoiding working it when it is too wet, (5) removing excessive water through increased tile drainage and minimizing compaction and (6) applying seed treatments that protect the plant during germination and early growth. **Due to anthracnose concerns, all seed should be treated with DCT. See the section on *Anthracnose (Colletotrichum lindemuthianum)*, on page 65, for more details.**	carbathiin + thiram	Vitaflo 280	260 mL	Ensure good seed coverage.
	fludioxonil + metalaxyl-m	Apron Maxx RTA	325 mL	For both commercial seed treatment plants and on-farm treatment using standard gravity- or mist-type seed treatment equipment. Compatible with Rhizobium-based inoculants. Check with inoculant manufacturers prior to use. Ensure uniform coverage.

Table 6–3. Chemical Control Options for Diseases in Dry Edible Beans (continued)

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (Days to harvest, label precautions, etc.)
FOLIAR, STEM AND POD DISEASES				
ASIAN SOYBEAN RUST *(Phakopsora pachyrhizi)*				
Edible beans are a host for Asian soybean rust. The extent to which these crops are impacted has yet to be determined. See the section *Asian Soybean Rust (Phakopsora pachyrhizi)*, on page 36, for more details on this disease. See the OMAFRA website for updates and further details on management options, as well as the Ontario Soybean Growers website at www.soybean.on.ca/.	pyraclostrobin	Headline EC	400–600 mL (160–240 mL)	Ground and aerial application. Maximum of 2 applications per year. Classified as a strobilurin fungicide and therefore must be used in a preventative fungicide program (pre-infection). See label for resistance management strategy. 7 days to harvest interval. 48 hr re-entry period.
	azoxystrobin	Quadris	500 mL (200 mL)	Ground and aerial application. Maximum of 2 applications per year. Classified as a strobilurin fungicide and therefore must be used in a preventative fungicide program (pre-infection). See label for resistance management strategy. 15 days to harvest interval.
	propiconazole	Tilt 250 E	500–750 mL (200–300 mL)	Ground and aerial application. Make first application at the first sign of disease followed by a second application 14 days after the first application, if environmental conditions are favourable for disease development. Maximum of 2 applications per year. See label for resistance management strategy. 30 days to harvest interval.
	azoxystrobin + propiconazole	Quilt	1.0–1.5 L (400–600 mL)	Ground and aerial application. Make the first application at the first sign of disease. Apply the high rate only under conditions of high disease pressures. A second application at a 14-day interval may be needed if conditions persist. Good spray coverage and canopy penetration are important for best results. Apply in a minimum of 45 L of water per hectare. Maximum of 2 applications per year. See label for resistance management strategy. 30 days to harvest interval.
BEAN RUST *(Uromyces appendiculatus)*			**per ha (per ac)**	
This disease is extremely rare in Ontario, arriving late in the season. Some dry bean market classes (e.g., pinto beans) can be very susceptible to rust. If rust arrives during flowering and early pod set, a treatment may be necessary.	propiconazole	Tilt 250 E	500 mL (200 mL)	Ground or aerial application. Apply when disease is first detected. Maximum of 2 applications per season. 28 days to harvest.
		Bumper 418 EC	300 mL (121 mL)	Ground or aerial application. Apply when disease is first detected. Maximum of 2 applications per season. 28 days to harvest.
	pyraclostrobin	Headline EC	400–600 mL (160–240 mL)	Ground or aerial application. Apply when disease first appears. If necessary, re-apply 10–14 days later if disease persists. Tank-mixing with insecticide is not recommended as this fungicide could affect insecticide efficacy. Tank-mixing with Lance is not recommended as precipitates can develop. Maximum of 2 applications per season. 7 days to harvest.

Table 6–3. Chemical Control Options for Diseases in Dry Edible Beans (continued)

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (Days to harvest, label precautions, etc.)
WHITE MOULD *(Sclerotinia sclerotiorum)*			**per ha (per ac)**	
Avoid soybeans, canola and other hosts in a 3-yr rotation, since these crops are susceptible to white mould. Rotate with non-host crops such as wheat, corn and barley. In fields with a history of the disease, select varieties with an upright structure. Lower plant populations and increased row width promote rapid drying of the plants and soil surface and therefore reduce potential for infection. Avoid excess fertilization. Those fields at risk have a past history of white mould and above-average foliage growth. **CAUTION:** Before treating with Ronilan (vinclozolin), check with your dealer or buyer concerning possible foreign import restrictions on Ronilan-treated edible beans.	vinclozolin	Ronilan EG	1.0 kg (400 g) 2 applications/yr 1.5 kg (600 g) 1 applications/yr	**See Caution note under IPM Options, left.** Apply at 30%–50% flowering with repeat application 7–14 days later at full bloom if disease persists. For one application, apply 1.5 kg at early to mid-bloom (30%–50%). Do not feed treated bean refuse to livestock. Use sufficient water to ensure thorough coverage of plant foliage. Tank-mixing with insecticide is not recommended, as this fungicide could affect insecticide efficacy. Do not apply with products containing boron. **45 days to harvest for common, adzuki and mung beans.**
	boscalid	Lance	560–770 g (227–312 g)	**Best used as a preventative measure.** Ground or aerial application. Apply at 20%–50% flowering. Apply a second time 7–10 days later up to 50% flowering if disease persists or weather conditions are favourable for disease development. Tank-mixing with insecticide is not recommended, as this fungicide could affect insecticide efficacy. Tank-mixing with Headline is not recommended, as precipitates can develop. Plantback interval of 14 days for crops not on label. 21 days to harvest.
	iprodione	Rovral WP	1.0–1.5 kg (0.4–0.6 kg)	Apply at 25%–75% bloom. 12-hr re-entry period. Do not feed treated bean refuse to livestock.
	thiophanate-methyl	Senator 70 WP	1.75–2.25 kg (700–900 g)	Apply when conditions favouring development of disease exist (warm, humid weather combined with heavy, dense crop foliage). Do not feed treated bean refuse to livestock. 14 days to harvest.
	dicloran	Botran 75 WP	3.25 kg (1.3 kg)	Begin application when disease is anticipated, usually close to full bloom. Do not feed treated bean refuse to livestock. 2 days to harvest.

7. Canola and Mustard

INSECTS

Table 7–1. Chemical Control Options for Insects in Canola and Mustard

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (Days to harvest, label precautions, etc.)
FLEA BEETLES *(Phyllotreta cruciferae* and *Phyllotreta striolata)*				
Seed Treatment			**per 100 kg seed**	
Hot, dry weather favours this pest. Fortunately, once the crop reaches the 3–4-leaf stage, the plants are generally established and can compensate for the feeding damage. If beetle damage exceeds 50% of the cotyledon or leaf area, and if the weather is warm and dry, a foliar insecticide may be needed. Canola and mustard are a valuable honey source and are well used by honeybees. Keep insecticide application to a minimum while the crop is in bloom.	imidacloprid	Gaucho 480 FL	820–1,640 mL	Not for use in hopper-box, planter-box, slurry-box or other non-commercial seed treatment application. Do not graze livestock on treated areas for 4 weeks after planting. Mustard greens having Gaucho 480 FL seed treatment must not be used for human consumption. Use higher rate if flea beetle populations are high.
	thiamethoxam + difenoconazole + metalaxyl M + fludioxonil	Helix Xtra	1.5 L	Not for use in hopper-box, planter-box, slurry-box or other non-commercial seed treatment application. Follow resistance management recommendations as stated on label.
	imidacloprid + carbaithiin + thiram	Gaucho CS FL	1.4 L	Not for use in hopper-box, planter-box, slurry-box or other non-commercial seed treatment application. Do not graze livestock on treated areas for 4 weeks after planting. Mustard greens having Gaucho CS seed treatment must not be used for human consumption. Follow resistance management recommendations as stated on label.
	clothianidin + carbathiin + thiram + metalaxyl	Prosper FL	1.25 L	Not for use in hopper-box, planter-box, slurry-box or other non-commercial seed treatment application. 30-day plant back on cereal grains, grasses, non-grass animal feeds, and soybean and dried beans is required. 1-year plant-back interval is required for leafy, root and tuber vegetables. Can be tank-mixed with Poncho 600 FS for longer season control of flea beetles. Follow resistance management recommendations as stated on label.

Table 7–1. Chemical Control Options for Insects in Canola and Mustard (continued)

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (Days to harvest, label precautions, etc.)
Postemergence			**per ha (per ac)**	
Canola is a valuable honey source and is utilized by honeybees. Bees also pollinate the crop. If spraying an insecticide, ensure there are no honey-producing hives in your area.	cypermethrin	Ripcord 400 EC	50 mL (20 mL)	Ripcord is registered for use on canola only. Ground and aerial application. 30 days to harvest. Ground application only. Apply when signs of insect damage appear. Repeat treatment if necessary. Use minimum 110 L of water/ha. 30 days to harvest.
	deltamethrin	Decis 5 EC	100–150 mL (40–60 mL)	Ground and aerial application. 14 days to harvest.
	cyhalothrin-lambda	Matador 120 EC	83 mL (33 mL)	Ground and aerial application. Maximum 3 applications/yr, 1 may be by air. Tank-mixing with clay-based fungicides (e.g., Lance or Ronalin) is not recommended as these fungicides may affect insecticide efficacy. Do not apply within 7 days of harvest.
	carbaryl	Sevin XLR Plus	500 mL (200 mL)	Seedling stage only (up to 4 weeks after plant emergence). Ground and aerial application. 60 days to harvest.
	carbofuran	Furadan 480 F	150 mL (60 mL)	Apply 2 weeks after seeding or when insects are first noticed. Ground and aerial application. Do not use less than 100 L of water. 60 days to harvest for canola and 21 days to harvest or grazing on mustard. Minimum period for re-entry is 48 hr.
DIAMONDBACK MOTH *(Plutella xylostella)*			**per ha (per ac)**	
Damage is most noticeable during dry years. Risk factors include weedy fields and no-till. Cool, cloudy weather reduces moth activity and if this persists, females will die before eggs are laid. Canola is a valuable honey source and is utilized by honeybees. Bees also pollinate the crop. If spraying an insecticide, ensure there are no honey-producing hives in your area.	cyhalothrin-lambda	Matador 120 EC	83 mL (33 mL)	Ground and aerial application. Maximum 3 applications/yr, 1 may be by air. Tank-mixing with clay-based fungicides (e.g., Lance or Ronalin) is not recommended as these fungicides may affect insecticide efficacy. Do not apply within 7 days of harvest.
CABBAGE SEEDPOD WEEVIL *(Ceutorhynchus obstrictus)*			**per ha (per ac)**	
Serious pest in winter canola, though can also impact early-planted spring canola. Adult weevils lay eggs directly into the seedpod. Pod feeding by the larvae can cause up to 35% yield loss. Foliar insecticide will not control larvae within the canola pod, therefore insecticide must be applied to adults prior to egg-laying. See the OMAFRA website for more information on biology, scouting techniques and thresholds. Canola is a valuable honey source and is utilized by honeybees. Bees also pollinate the crop. If spraying an insecticide, ensure there are no honey -producing hives in your area.	cyhalothrin-lambda	Matador 120 EC	83 mL (33 mL)	**For adult control only.** Ground and aerial application. Apply at bud to early flowering stage. Maximum 1 application/yr. Tank-mixing with clay-based fungicides (e.g., Lance or Ronalin) is not recommended, as these fungicides may affect insecticide efficacy. Do not apply within 7 days of harvest.

Table 7–1. Chemical Control Options for Insects in Canola and Mustard (continued)

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (Days to harvest, label precautions, etc.)
SWEDE MIDGE *(Contarinia nasturtii)*				
New pest of canola in Ontario. Under heavy midge infestations, later-planted spring canola plants may experience stunting and malformed growth, with extremely reduced flower and pod formation. Thresholds and spray timing are not available at this time. For more information on this pest, see the OMAFRA website. Quarantine restrictions apply to those counties in Ontario and Quebec identified as having swede midge. See the CFIA website at: www.inspection.gc.ca/english/plaveg/pestrava/connas/connase.shtml for more information on plant movement restrictions.				No registered products at this time.
TARNISHED PLANT BUG *(Lygus lineolaris)*				
Tarnished plant bug sting plant tissue, including pods and flowers. This causes scarring, malformation and dimpling or pitting on pods. They can also drill into the seed. If flowers are still present, they can prick the flower and cause them to abort. Though no thresholds have been validated for Ontario, spraying is recommended when 2 bugs per sweep are found after petal fall.	cyhalothrin-lambda	Matador 120 EC	83 mL (33 mL)	Ground and aerial application. Apply at bud-to-early-flowering stage. Maximum 1 application/yr. Tank-mixing with clay-based fungicides (e.g., Lance or Ronalin) is not recommended, as these fungicides may affect insecticide efficacy. Do not apply within 7 days of harvest.

Table 7–2. Chemical Control Options for Diseases in Canola and Mustard

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (Days to harvest, label precautions, etc.)
SEEDLING DISEASES				
SEED ROT AND SEEDLING BLIGHT (*Alternaria* and *Rhizoctonia*)			**per 100 kg seed**	
Plant good-quality seed under conditions that promote rapid germination (warm temperatures). Using a fungicide seed treatment will increase stand establishment. Maintain a good fertility balance and avoid excess fertilizer, which promotes disease and phytotoxicity. Avoid deep planting of seed.	thiamethoxam + difenoconazole + metalaxyl M + fludioxonil	Helix Xtra	1.5 L	Not for use in hopper-box, planter-box, slurry-box or other non-commercial seed treatment application. Follow resistance management recommendations as stated on label.
	carbathiin + thiram	Vitavax RS Fungicide	833 mL	Do not graze or feed livestock on seed area for 4 weeks after planting.
	imidacloprid + carbathiin + thiram	Gaucho CS FL	1.4 L	Not for use in hopper-box, planter-box, slurry-box or other non-commercial seed treatment application. Do not graze livestock on treated areas for 4 weeks after planting. Mustard greens having Gaucho CS seed treatment must not be used for human consumption. Follow resistance management recommendations as stated on label.
PYTHIUM DAMPING-OFF (*Pythium* spp.)			**per 100 kg seed**	
Plant good-quality seed under conditions that promote rapid germination (warm temperatures). Using metalaxyl or metalaxyl-M seed treatment will increase stand establishment. Maintain a good fertility balance and avoid excess fertilizer, which promotes disease and phytotoxicity. Avoid deep planting of seed.	metalaxyl-M	Apron XL LS	20–40 mL	Canola only. Do not use in hopper-box, planter-box, slurry-box or other non-commercial seed treatment applications at or immediately before planting. Read label for information regarding resistant strains of fungus.
	metalaxyl	Apron FL	32–110 mL	Canola only. Do not graze or feed livestock on seeded area for 4 weeks after planting.
	thiamethoxam + difenoconazole + metalaxyl M + fludioxonil	Helix Xtra	1.5 L	Not for use in hopper-box, planter-box, slurry-box or other non-commercial seed treatment application. Follow resistance management recommendations as stated on label.

Table 7–2. Chemical Control Options for Diseases in Canola and Mustard (continued)

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (Days to harvest, label precautions, etc.)
BLACKLEG *(Leptosphaeria maculans)*				
Seed Treatment			**per 100 kg seed**	
There are differences in susceptibility between cultivars. Maintain at least 3 yr between canola crops. Fungicide seed treatments will reduce seed-borne infection.	thiamethoxam + difenoconazole + metalaxyl M + fludioxonil	Helix Xtra	1.5 L	Not for use in hopper-box, planter-box, slurry-box or other non-commercial seed treatment application. Follow resistance management recommendations as stated on label.
	carbathiin + thiram	Vitavax RS Fungicide	833 mL	Do not graze or feed livestock on seed area for 4 weeks after planting.
	imidacloprid + carbathiin + thiram	Gaucho CS FL	1.4 L	Not for use in hopper-box, planter-box, slurry-box or other non-commercial seed treatment application. Do not graze livestock on treated areas for 4 weeks after planting. Mustard greens having Gaucho CS seed treatment must not be used for human consumption. Follow resistance management recommendations as stated on label.
Foliar Treatment			**per ha (per ac)**	
A foliar fungicide may be warranted if blackleg symptoms occur at the seedling and rosette stages or if a susceptible variety is being grown.	propiconazole	Tilt 250 E	500 mL (200 mL)	Canola only. Ground and aerial application. Apply at rosette stage. Do not feed treated canola refuse to livestock. 60 days to harvest.
		Bumper 418 EC	300 mL (121 mL)	Canola only. Apply during the rosette stage, between 2nd true leaf and bolting. 60 days to harvest.
	azoxystrobin	Quadris	500 mL (200 mL)	Canola only. Apply at 2–6-leaf stage. See label for information regarding resistant strains of fungus. Plant-back interval of 30 days for broadleaf and root crops and 45 days for cereals required. 30 days to harvest.
SCLEROTINIA STEM ROT (WHITE MOULD) *(Sclerotinia sclerotiorum)*			**per ha (per ac)**	
This disease is often a problem when canola follows canola, white beans, soybeans or sunflowers. Use clean seed and a 4–5-year rotation with non-host crops such as corn, wheat, barley or oats. At present, no resistant varieties exist. Keep fields clean of broad-leaved weeds, since many are alternate hosts.	vinclozolin	Ronilan EG	0.5 kg (0.2 kg) for 2 applications	Canola only. For 2 applications, apply first at 20%–30% flowering and second 7 days later at late bloom (50%) if disease persists.
			0.75–1.0 kg (300–400 g) for 1 application	For single application at higher rates, apply at 20%–50% flower. Use the high rate where conditions are extremely favourable for disease development (heavy crop canopy, high humidity and/or excessive rainfall). Do not feed treated canola refuse to livestock. Use sufficient water to ensure thorough coverage of plant foliage. Tank-mixing with insecticide is not recommended, as this fungicide could affect insecticide efficacy. Do not apply with products containing boron. 40 days to harvest.
	iprodione	Rovral WP	1.0–1.5 kg (0.4–0.6 kg)	Canola only. Ground and aerial application. Apply at 20%–30% bloom. 12-hr re-entry period.
	azoxystrobin	Quadris	700–1,000 mL (283–405 mL)	Canola only. Apply at early bloom (prior to 30% bloom). See label for information regarding resistant strains of fungus. Plant-back interval of 30 days for broadleaf and root crops and 45 days for cereals required. 30 days to harvest.
	boscalid	Lance	350 g (142 g)	Canola only. Ground and aerial applications. Apply at 20%–50% flowering. Apply a second time 7–10 days later up to 50% flowering if disease persists or weather conditions are favourable for disease development. Tank-mixing with insecticide is not recommended as this fungicide could affect insecticide efficacy. 21 days to harvest.

8. Stored Grain

INSECTS

Table 8–1. Chemical Control Options for Insects in Corn, Wheat and Soybeans

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (Days to harvest, label precautions, etc.)
RUSTY GRAIN BEETLE *(Cryptolestes ferrugineus)*				
Protectant				
The key to controlling stored-grain insects is prevention through good sanitation and storage practices. See OMAFRA Publication 811, *Agronomy Guide for Field Crops*, for more information on stored grain insect management.	diatomaceous earth	Protect-It	Empty bin: 500 per 100 m^2 Stored grain: 500–1,000 g/ metric tonne of grain	Can be applied to dry containers where grain is transported or stored. The structure must remain empty for 1–2 weeks. For maximum effectiveness, the relative humidity must remain below 55% and the temperature above 15°C (59°F). See label for spot and crack treatment rates. For wheat grain treatment, 100 g/tonne of wheat can be used to control rusty grain beetle. Dust may be applied to grain as it enters the auger or conveyor feeder system during grain transfer into the storage facility.
Fumigant			**Grain bin, per 100 m^3**	
	aluminum phosphide	Fumitoxin	880–2,560 pellets 250–500 tablets	Must be applied by a professional licensed applicator. Do not fumigate below 5°C (40°F). Exposure to moist air or liquids releases flammable and toxic phosphine gas. Ensure bin is tightly sealed. Not to be used for vacuum fumigations. See label for minimum length of pest exposure periods at various temperatures.
		Phostoxin	880–2,560 pellets 250–500 tablets	
		Gastoxin	880–2,500 pellets 180–500 tablets	
INDIAN MEAL MOTH *(Plodia interpuctella)*				
Protectant				
The key to controlling stored-grain insects is prevention through good sanitation and storage practices. See OMAFRA Publication 811, *Agronomy Guide for Field Crops*, for more information on stored grain insect management.	diatomaceous earth	Protect-It	Empty bin: 500 per 100 m^2 Stored grain: 500–1,000 g/ metric tonne of grain	Apply at monthly intervals with the first appearance of moths and continue until early fall. In severe infestations, break up webbing with a rake before dusting and make second application 2 weeks later. Can be applied to dry containers where grain is transported or stored. The structure must remain empty for 1–2 weeks. For maximum effectiveness, the relative humidity must remain below 55% and the temperature above 15°C (59°F). See label for spot and crack treatment rates. Dust may be applied to grain as it enters the auger or conveyor feeder system during grain transfer into storage facility.
Fumigant			**Grain bin, per 100 m^3**	
	aluminum phosphide	Fumitoxin	880–2,560 pellets 250–500 tablets	Must be applied by a professional licensed applicator. Do not fumigate below 5°C (40°F). Exposure to moist air or liquids releases flammable and toxic phosphine gas. Ensure bin is as tightly sealed as possible. Not to be used for vacuum fumigations. See label for minimum length of pest exposure periods at various temperatures.
		Phostoxin	880–2,560 pellets 250–500 tablets	
		Gastoxin	880–2,500 pellets 180–500 tablets	

Table 8–1. Chemical Control Options for Insects in Corn, Wheat and Soybeans (continued)

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (Days to harvest, label precautions, etc.)
GRANARY WEEVIL *(Sitophilus granarius)*				
Protectant				
The key to controlling stored-grain insects is prevention through good sanitation and storage practices. See OMAFRA Publication 811, *Agronomy Guide for Field Crops*, for more information on stored grain insect management.	diatomaceous earth	Protect-It	Empty bin: 500 g per 100 m^2 Stored grain: 500–1000 g/ metric tonne of grain.	Can be applied to dry containers where grain is transported or stored. The structure must remain empty for 1–2 weeks. For maximum effectiveness, the relative humidity must remain below 55% and the temperature above 15°C (59°F). See label for spot and crack treatment rates. Dust may be applied to grain as it enters the auger or conveyor feeder system during grain transfer into the storage facility.
Fumigant			**Grain bin, per 100 m^3**	
	aluminum phosphide	Fumitoxin	880–2,560 pellets 250–500 tablets	Must be applied by a professional licensed applicator. Do not fumigate below 5°C (40°F). Exposure to moist air or liquids releases flammable and toxic phosphine gas. Ensure bin is as tightly sealed as possible. Not to be used for vacuum fumigations. See label for minimum length of pest exposure periods at various temperatures.
		Phostoxin	880–2,560 pellets 250–500 tablets	
		Gastoxin	880–2,500 pellets 180–500 tablets	
LESSER GRAIN BORER *(Rhyzopertha dominica)*				
Fumigant			**Grain bin, per 100 m^3**	
The key to controlling stored-grain insects is prevention through good sanitation and storage practices. See OMAFRA Publication 811, *Agronomy Guide for Field Crops*, for more information on stored grain insect management.	aluminum phosphide	Fumitoxin	880–2,560 pellets 250–500 tablets	Must be applied by a professional licensed applicator. Do not fumigate below 5°C (40°F). Exposure to moist air or liquids releases flammable and toxic phosphine gas. Ensure bin is as tightly sealed as possible. Not to be used for vacuum fumigations. See label for minimum length of pest exposure periods at various temperatures.
		Phostoxin	880–2,560 pellets 250–500 tablets	
		Gastoxin	880–2,500 pellets 180–500 tablets	
PEA WEEVILS/BEAN WEEVILS *(Bruchus pisorum/Acanthoscelides obtectus)*				
Fumigant			**Grain bin, per 100 m^3**	
The key to controlling stored-grain insects is prevention through good sanitation and storage practices. See OMAFRA Publication 811, *Agronomy Guide for Field Crops*, for more information on stored grain insect management.	aluminum phosphide	Fumitoxin	880–2,560 pellets 250–500 tablets	Must be applied by a professional licensed applicator. Do not fumigate below 5°C (40°F). Exposure to moist air or liquids releases flammable and toxic phosphine gas. Ensure bin is as tightly sealed as possible. Not to be used for vacuum fumigations. See label for minimum length of pest exposure periods at various temperatures.
		Phostoxin	880–2,560 pellets 250–500 tablets	
		Gastoxin	880–2,500 pellets 180–500 tablets	
EUROPEAN GRAIN MOTH *(Nemapogon granella)*				
Fumigant			**Grain bin, per 100 m^3**	
The key to controlling stored-grain insects is prevention through good sanitation and storage practices. See OMAFRA Publication 811, *Agronomy Guide for Field Crops*, for more information on stored grain insect management.	aluminum phosphide	Fumitoxin	880–2,560 pellets 250–500 tablets	Must be applied by a professional licensed applicator. Do not fumigate below 5°C (40°F). Exposure to moist air or liquids releases flammable and toxic phosphine gas. Ensure bin is as tightly sealed as possible. Not to be used for vacuum fumigations. See label for minimum length of pest exposure periods at various temperatures.
		Phostoxin	880–2,560 pellets 250–500 tablets	
		Gastoxin	880–2,500 pellets 180–500 tablets	

9. Appendices

Appendix A.
Manufacturers of Pesticides Recommended in Publication 812

BASF Canada Inc.
110 Milverton Dr., 5th floor
Mississauga, Ontario L5R 4H1
Tel 1-877-371-2273
Fax 1-289-360-6001
www.agsolutions.ca

Bayer CropScience
100-3131 114th Ave. SE
Calgary, Alberta T2Z 3X2
Tel 1-888-283-6847
Fax 403-723-7488
www.bayercropscience.ca

Bio-Lab Canada – A Chemtura Company
1005 Copperstone Dr.
Pickering, Ontario
Canada L1W 4A5
Tel 905-686-8836
Fax 905-619-8696
www.chemtura.com

Dow AgroSciences Solutions Centre
#201-1144 29th Ave. NE
Calgary, Alberta T2E 7P1
Tel 1-800-667-3852
Fax 1-888-296-6188
www.dowagro.ca

DuPont Canada Inc.
7070 Mississauga Rd., Box 2300
Streetsville, Ontario L5M 2H3
Tel 1-800-387-2122
Fax 905-821-5653
http://ca.dupont.com

Engage Agro Corp.
848 Gordon St.
Guelph, Ontario N1G 1Y7
Tel 519-826-7878
Fax 519-826-7675
www.engageagro.com

Gowan Company
370 South Main St.
Yuma, Arizona 85364 USA
Tel 1-800-883-1844, ext. 2
www.gowanco.com

Growmark Inc.
2000 Argentia Rd., P.O. Box 634
Mississauga, Ontario L5M 2C1
Tel 905-814-4266
Fax 905-814-4341
www.growmark.com

Interprovincial Cooperative Ltd.
945 Marion St.
Winnipeg, Manitoba R2J 0K7
Tel 204-233-3461
www.ipco.ca

Monsanto Canada
67 Scurfield Blvd.
Winnipeg, Manitoba R37 1G4
Tel 1-800-667-4944
Fax 204-488-9599
www.monsanto.ca

Norac Concepts Inc.
P. O. Box 62023
Ottawa, Ontario K1C 7H8
Tel 613-841-2907
Fax 613-841-2908
www.noracconcepts.com

Syngenta Crop Protection Canada Inc.
140 Research Lane
Guelph, Ontario N1G 4Z3
Tel 1-800-459-2422
Fax 519-823-8439
www.syngenta.ca

Syngenta Seeds Canada Inc.
15910 Medway Rd.
Arva, Ontario N0M 1C0
Tel 1-800-756-7333
Fax 1-888-717-7122
www.nkcanada.com

Thermo Trilogy Corporation
9145 Guilford Rd., Ste. 175
Columbia, Maryland 21046 USA
www.thermotrilogy.com

United Agri Products Canada Inc.
789 Donnybrook Dr.
Dorchester, Ontario N0L 1G5
Tel 1-800-265-4624
Fax 519-268-8013
www.uap.ca

Valent BioSciences Canada Ltd.
19 Wildan Dr. Box 19
Freelton, Ontario L0R 1K0
Tel 905-659-0886
Fax 905-659-0885
www.valentbiosciences.com

Appendix B.
Ontario Ministry of Agriculture, Food and Rural Affairs Crop Advisory Staff List by Location

Specialty	Staff/E-mail	Phone/Fax
Brighton Resource Centre 95 Dundas St., RR # 3 Brighton, ON K0K 1H0		**613-475-1630** Fax 613-475-3835
IPM Systems Specialist	Margaret Appleby margaret.appleby@ontario.ca	613-475-5850
Fergus Resource Centre RR # 1, County Road 18, Wellington Place, Fergus, ON N1M 2W3		519-846-0941 Fax 519-846-8178
Agroforestry Specialist	Todd Leuty todd.leuty@ontario.ca	519-846-3390
Guelph - Government Information Centre 1 Stone Rd. W., Guelph ON N1G 4Y2		888-466-2372 or 519-826-3100
Guelph OMAFRA 1 Stone Rd. W., Guelph, ON N1G 4Y2		
Director Agriculture Development	Aileen MacNeil aileen.macneil@ontario.ca	519-826-6588 Fax 519-826-3567
Manager Greenhouse, Agroforestry and Specialty Crops	Annette Anderson annette.anderson@ontario.ca	519-826-3286 Fax 519-826-3567
Manager Horticulture Technology	Hugh Berges hugh.berges@ontario.ca	519-826-3288 Fax 519-826-3567
Manager Horticulture Crops	John Finlay john.finlay@ontario.ca	519-826-6941 Fax 519-826-3567
Manager Field Crops	Brent Kennedy brent.kennedy@ontario.ca	519-826-3257 Fax 519-826-3567
Minor Use Coordinator	Jim Chaput jim.chaput@ontario.ca	519-826-3539 Fax 519-826-4964
Product Development Specialist	Kelly Ward — on leave kelly.l.ward@ontario.ca	519-826-4094 Fax 519-826-4964
Vegetable Crops Specialist	Jennifer Allen jennifer.allen@ontario.ca	519-826-4963 Fax 519-826-4964
Organic Crop Protection Program Lead	Hugh Martin hugh.martin@ontario.ca	519-826-4587 Fax 519-826-4964
Crop Protection Program Lead	Denise Beaton denise.beaton@ontario.ca	519-826-6594 Fax 519-826-4964
Potato Specialist	Eugenia Banks eugenia.banks@ontario.ca	519-826-3678 Fax 519-826-4964
Crop Bioproducts Specialist	Mahendra Thimmanagari mahendra.thimmanagari@ontario.ca	519-826-4593 Fax 519-826-3567

Appendix B.
Ontario Ministry of Agriculture, Food and Rural Affairs Crop Advisory Staff List by Location (continued)

Specialty	Staff/E-mail	Phone/Fax
Harrow Greenhouse and Processing Crops Research Centre, 2585 County Road 20, Harrow, ON N0R 1G0		**519-738-2251** Fax 519-738-4564
Greenhouse Vegetable IPM Specialist	Gillian Ferguson gillian.ferguson@ontario.ca	519-738-1258
Weed Management Horticulture Program Lead	Leslie Huffman leslie.huffman@ontario.ca	519-738-1256
Greenhouse Vegetables Specialist	Shalin Khosla shalin.khosla@ontario.ca	519-738-1257
Kemptville Resource Centre Box 2004, Concession Rd., Kemptville, ON K0G 1J0		**613-258-8295** Fax 613-258-8392
Emerging Crops Specialist	Scott Banks scott.banks@ontario.ca	613-258-8359
Agroforestry Specialist	Dave Chapeskie dave.chapeskie@ontario.ca	613-258-8302
Field Crops IPM Program Lead Bilingual	Gilles Quesnel gilles.quesnel@ontario.ca	613-258-8250
Lindsay Resource Centre 322 Kent St. W., Lindsay, ON K9V 2Z9		**705-324-6125** Fax 705-324-1638
Forages Specialist	Joel Bagg joel.bagg@ontario.ca	705-324-5856
London Resource Centre 667 Exeter Rd., London, ON N6E 1L3		**519-873-4070** Fax 519-873-4062
Apples Specialist	John Gardner john.gardner@ontario.ca	519-873-4084
New Liskeard 280 Armstrong St., Box 4070, New Liskeard, ON P0J 1P0		**705-647-2085** Fax 705-647-7993
Agriculture and Rural Representative Northeastern Ontario	Daniel Tasse daniel.tasse@ontario.ca	705-647-2085
Ridgetown Resource Centre Agronomy Building, University of Guelph, Ridgetown Campus, Box 400, Main St. E., Ridgetown, ON N0P 2C0		**519-674-1690** Fax 519-674-1564
Soil Management Field Crops Specialist	Adam Hayes adam.hayes@ontario.ca	519-674-1621
Pathologist Field Crops Program Lead	Albert Tenuta albert.tenuta@ontario.ca	519-674-1617
Vegetable Crops Specialist	Elaine Roddy elaine.roddy@ontario.ca	519-674-1616
Soil Management Horticulture Specialist	Anne Verhallen anne.verhallen@ontario.ca	519-674-1614
Entomology Field Crops Program Lead	Tracey Baute tracey.baute@ontario.ca	519-674-1696
Vegetable Crops Specialist	Janice LeBoeuf janice.leboeuf@ontario.ca	519-674-1699

Appendix B.
Ontario Ministry of Agriculture, Food and Rural Affairs Crop Advisory Staff List by Location (continued)

Specialty	Staff/E-mail	Phone/Fax
Simcoe Resource Centre P.O. Box 587, Blueline Rd & Hwy #3, Simcoe, ON N3Y 4N5		**519-426-7120** Fax 519-428-1142
New Crop Development Specialist	Mike Columbus mike.columbus@ontario.ca	519-426-4509
Berry Crops Specialist	Pam Fisher pam.fisher@ontario.ca	519-426-2238
Ginseng and Medicinal Herbs Specialist	Jan Schooley jan.schooley@ontario.ca	519-426-4323
Fresh Market Quality Program Lead	Jennifer DeEll jennifer.deell@ontario.ca	519-426-1408
Pome Fruit IPM Specialist	Kathryn Carter kathryn.carter@ontario.ca	519-426-4322
IPM Specialist – Specialty Crops	Melanie Filotas melanie.filotas@ontario.ca	519-426-4434 Fax 519-428-1142
Transition Crops Specialist	Jim Todd jim.todd@ontario.ca	519-426-3823 Fax 519-428-1142
Stratford Resource Centre 581 Huron St., Stratford, ON N5A 5T8		**519-271-0280** Fax 519-273-5278
Edible Bean and Canola Specialist	Brian Hall brian.hall@ontario.ca	519-271-0083
Cereals Specialist	Peter Johnson peter.johnson@ontario.ca	519-271-8180
Soil Fertility Specialist	Keith Reid keith.reid@ontario.ca	519-271-9269
Soybeans Specialist	Horst Bohner horst.bohner@ontario.ca	519-271-5858
Vineland – HRIO, University of Guelph Box 7000, 4890 Victoria Ave. N., Vineland Station, ON L0R 2E0		**905-562-4141** Fax 905-562-3413
Greenhouse Floriculture Specialist	Wayne Brown wayne.brown@ontario.ca	905-562-4141, ext. 179
Greenhouse Floriculture IPM Specialist	Graeme Murphy graeme.murphy@ontario.ca	905-562-414, ext. 106
Vineland Resource Centre Advisory Services Building, Box 8000, 4890 Victoria Ave. N., Vineland Station, ON L0R 2E0		**905-562-4147** Fax 905-562-5933
Tender Fruit and Grape Specialist	Ken Slingerland ken.slingerland@ontario.ca	905-562-1639
Nutrient Management Horticulture Program Lead	Donna Speranzini donna.speranzini@ontario.ca	905-562-1170
Entomology Horticulture Program Lead	Hannah Fraser hannah.fraser@ontario.ca	905-562-1674
Tender Fruit and Grape IPM Specialist	Neil Carter neil.carter@ontario.ca	905-562-3833

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Ontario Ministry of Agriculture, Food and Rural Affairs Crop Advisory Staff List by Location (continued)

Specialty	Staff/E-mail	Phone/Fax
Woodstock Resource Centre Box 666, Hwy. #59 N., Woodstock, ON N4S 7Z5		**519-537-6621** Fax 519-539-5351
Nutrient Management Field Crops Program Lead	Christine Brown christine.brown1@ontario.ca	519-537-8305
University of Guelph 50 Stone Rd. E., Guelph, ON N1G 2W1		519-824-4120
Turfgrass Specialist Guelph Turfgrass Institute, 328 Victoria Rd. S., R.R. # 2 Guelph, ON N1H 6H8	Pam Charbonneau pamela.charbonneau@ontario.ca	519-824-4120, ext. 52597 Fax 519-766-1704
Pathologist Horticulture Program Lead, Edmund Bovey Building	Michael Celetti michael.celetti@ontario.ca	519-824-4120, ext. 58910 Fax 519-767-0755
Nursery Crops Specialist Edmund Bovey Building	Jennifer Llewellyn jennifer.llewellyn@ontario.ca	519-824-4120, ext. 52671 Fax 519-767-0755
Nutrition, Horticulture Program Lead Land Resource Science, Richards Building	Peter Zwart peter.zwartl@ontario.ca	519-824-4120, ext. 52480 Fax 519-824-5730
Weed Management, Field Crops Program Lead Crop Science Building, Room 303	Mike Cowbrough mike.cowbrough@ontario.ca	519-824-4120, ext. 52580 Fax 519-763-8933
Applied Research Coordinator — Field Crops Crop Science Building	Ian McDonald ian.mcdonald@ontario.ca	519-824-4120, ext. 56707 Fax 519-763-8933
Corn Industry Program Lead Crop Science Building	Greg Stewart greg.stewart1@ontario.ca	519-824-4120, ext. 54865 Fax 519-763-8933

Agricultural Information Contact Centre
General Phone 877-424-1300 or 519-826-4047 Fax 519-826-7610

Provides province-wide, toll-free technical and business information to commercial farms, agri-businesses and rural businesses.

1 Stone Rd. W., Guelph ON N1G 4Y2
e-mail ag.info.omafra@ontario.ca

Guelph — Government Information Centre and Publication Order Centre
Staff Directories — Phone 1-888-466-2372 or 519-826-3100
1 Stone Rd. W., Guelph ON N1G 4Y2

Appendix C.
Ontario Classification Schedules

Explanation of Schedules

Schedule 1 Restricted. Use permit only.

Schedule 2 Restricted to certified agriculturalists, licenced exterminators, registered custom sprayers and permit holders.

Schedule 3 Agriculturists and consumer use.

Schedule 4 "Domestic" products only.

Schedule 5 Limited to application on agricultural land. Similar to Schedule 2.

Schedule 6 Similar to Schedule 4 but may be registered for agricultural/commercial use. Container size 1 L or greater.

For more information on the regulatory aspects of the classification, please contact the Ministry of the Environment office nearest you. See Appendix D, *Ontario Ministry of the Environment Pesticide Control Offices*, below, for a listing of MOE offices.

Appendix D.
Ontario Ministry of the Environment Pesticide Control Offices

REGION County	Address	Telephone
Central Region Toronto, Halton, Peel York, Durham	5775 Yonge St., 8th Floor Toronto, Ontario M2M 4J1	416-326-3671 Toll Free 1-800-810-8048 Fax 416-325-6345
West-Central Region Haldimand-Norfolk, Niagara, Hamilton-Wentworth, Dufferin, Wellington, Waterloo, Brant	Ontario Government Building 119 King St. W., 12th floor Hamilton, Ontario L8P 4Y7	905-521-7667 Fax 905-521-7820
Eastern Region Frontenac, Hastings, Lennox & Addington, Prince Edward, Leeds & Grenville, Prescott & Russell, Stormont/Dundas & Glengarry , Haliburton, Peterborough, Victoria, Northumberland, Renfrew, Ottawa-Carleton, Lanark, District of Nipissing (Twsps of Airy, Murchison, Dickens, Lyell and Sabine)	133 Dalton Ave. P.O. Box 820 Kingston, Ontario K7L 4X6	613-549-5047 Toll Free 1-800-267-0974 Fax 613-548-6908
Southwestern Region Elgin, Middlesex, Oxford, Essex, Kent, Lambton, Bruce, Grey, Huron, Perth,Simcoe	733 Exeter Rd. London, Ontario N6E 1L3	519-873-5041 519-873-5048 Fax 519-873-5020
Northern Region Manitoulin, Nipissing, Parry Sound, Sudbury, Algoma East, Cochrane East, Muskoka,	199 Larch St., Ste. 1101 Sudbury, Ontario P3E 5P9	705-564-3237 Fax 705-564-4180
Kenora, Rainy River, Thunder Bay, Algoma West, Cochrane West, Timmins	435 James St. S., Ste. 331 Thunder Bay, Ontario P7E 6S7	(807) 475-1205 Fax (807) 475-1745
Standards Development Branch	Pesticides Section 40 St. Clair Ave. W., 7th floor Toronto, Ontario M4V 1M2	416-327-5519 Fax 416-327-2936
Approvals Branch	Pesticides Licensing 2 St. Clair Ave. W., 12A floor Toronto, Ontario M4V 1L5	416-314-8001 Fax 416-314-8452

Appendix E.
Diagnostic Service

Samples for disease diagnosis, insect or weed identification, nematodes counts and Verticillium testing can be sent to:

Pest Diagnostic Clinic
Laboratory Services Division
University of Guelph
95 Stone Rd. W.,
GUELPH, Ontario, N1H 8J7

Tel 519-767-6256
Fax 519-767-6240
E-mail *pdc@lsd.uoguelph.ca*

Payment must accompany samples at the time of submission.

SUBMISSION FORMS ARE AVAILABLE AT:
www.uoguelph.ca/pdc

Charges will be applied to each sample submitted.
Payment: Please make cheque payable to the University of Guelph. VISA and Mastercard are also accepted. Please do not mail cash.

How to Sample for Nematodes

Soil

When to Sample

Soil and root samples can be taken at any time of the year whenever the soil is not frozen. In Ontario, nematode soil population levels are generally at their highest in May–June and again in September–October.

How to Sample Soil

Take samples with a soil sampling tube, trowel or narrow bladed shovel. Sample soil to a depth of 20–25 cm (8–10 in.). If the soil is bare, remove the top 2 cm (1 in.) prior to sampling. A sample should consist of 10 or more subsamples combined. Mix well. Then take a sample of $^1/_2$–1 L (1 pint to 1 quart) from this. No one sample should represent more than 2.5 ha (6.25 ac).

Mix subsamples in a clean pail or plastic bag.

Sampling Pattern

If living crop plants are present in the sample area, take samples within the row and from the area of the feeder root zone (with trees, this is the drip line).

Number of Subsamples

Based on the total area sampled

500 m^2 (5,400 ft^2)	10 subsamples
500 m^2–0.5 ha (5,400 ft^2–1.25 ac)	25 subsamples
0.5 ha–2.5 ha (1.25–6.25 ac)	50 subsamples

Roots

From small plants, sample entire root system plus adhering soil. For large plants, 10–20 g ($^1/_2$–1 oz.), dig fresh weight from the feeder root zone and submit.

Problem Areas

Take soil and root samples from the margins of the problem area where the plants are still living. If possible, take both soil and root samples from problem and healthy areas in the same field.

Sample Handling

Soil Samples

Place in plastic bags as soon as possible after collecting.

Root Samples

Place in plastic bags and cover with moist soil from the sample area.

Storage

Store samples between 5 °C and 10 °C (40 °F and 50 °F) and do not expose to direct sunlight or extreme heat or cold (freezing). **Only living nematodes can be counted. Accurate counts depend on proper handling of samples.**

Submitting Plant for Disease Diagnosis or Identification

Sample Submission Forms

Obtain forms from your local OMAFRA office. Carefully fill in all of the categories on the form. In the space provided, draw the most obvious symptom and the pattern of the disease in the field. It is important to include the cropping history of the area for the past 3 years and this year's pesticide use records.

Choose a complete, representative sample showing early symptoms. Submit as much of the plant as is practical, including the root system, or several plants showing a range of symptoms. For turfgrass, submit a 10–15-cm-square piece of turf, including thatch and at least 5 cm of soil. Take the sample from the outside edge of a ring or patch and include healthy and unhealthy turf and the interface between. If symptoms are general, collect the sample from an area where they are of intermediate severity. **Completely dead material is usually inadequate for diagnosis.** With plant specimens submitted for identification, include a 20–25-cm sample of the top portion of the stem with lateral buds, leaves, flowers or fruits in identifiable condition. Wrap plants in newspaper and put in a plastic bag. Tie the root system off in a separate plastic bag to avoid drying out and soil contaminating the leaves. **DO NOT** add moisture, as this encourages decay in transit. Cushion specimens and pack in a sturdy box to avoid damage during shipping. Avoid leaving specimens to bake or freeze in a vehicle or in a location where they could deteriorate.

Delivery

Deliver to the Pest Diagnostic Clinic as soon as possible by first class mail or by courier at the beginning of the week.

Submitting Insect Specimens for Identification

Collecting Samples

Place dead, hard-bodied insects and spiders in vials or boxes, cushioned with tissues or cotton. Put soft-bodied insects and caterpillars in vials containing alcohol. Do not use water, as this will result in rot. Do not tape insect to paper or send them loose in an envelope.

Place live insects in a container with enough plant "food" to support them during transit. Be sure to write "live" on the outside of the container.

Appendix F.
Other Contacts

AGRICULTURE & AGRI-FOOD CANADA RESEARCH CENTRES

Eastern Cereals and Oilseeds Research Centre
960 Carling Ave.
Ottawa, K1A 0C6
Tel 613-759-1952
http://res2agr.ca/ecorc/welcome.htm

Greenhouse and Processing Crops Centre
Harrow N0R 1G0
Tel 519-738-2251
http://res2.agr.ca/harrow/

Southern Crop Protection and Food Research Centre
http://res2.agr.ca/london/pmrc/pmrchome.html

1391 Sandford St.
London N5V 4T3
Tel 519-457-1470

Vineland Research Farm
4902 Victoria Ave. N.
Vineland L0R 2E0
Tel 905-562-4113

Delhi Research Farm
Box 186 Schafer Rd.
Delhi N4B 2W9
Tel 519-582-1950

CANADIAN FOOD INSPECTION AGENCY REGIONAL OFFICES (PLANT PROTECTION)

www.cifa-acia.agr.ca

Belleville
345 College St. E.
Belleville, K8N 5S7
Tel 613-969-3333

Brantford
Federal Building, Dalhousie & Queen St.
P.O. Box 637
Brantford, N3T 5P9
Tel 519-751-8157

Hamilton
709 Main St. W., Suite 101
Hamilton, L8S 1A2
Tel 905-572-4152

London
457 Richmond St., Ste. 404
London, N6A 3E3
Tel 519-645-4021

Niagara Falls
Mailing address:
P.O. Box 35, Niagara Falls, L2E 6S8

Street address:
4551 Zimmerman Ave.
Niagara Falls, L2E 3M5
Tel 905-357-5981

Ottawa District
3 Observatory Cres.
Building #3 Central, Experimental Farm
Ottawa, K1A 0C9
Tel 613-759-1571

Toronto
401 Champagne Dr., Unit 1
Downsview, M3J 2C6
Tel 416-954-1714

Windsor
441 University Ave. W., Ste. 208
Windsor, N9A 5P9
Tel 519-252-7095

UNIVERSITY OF GUELPH

Main Campus
Guelph, N1G 2W1
Tel 519-824-4120
www.uoguelph.ca

Alfred Campus
Alfred, K0B 1A0
Tel 613-679-2218
www.alfredc.uoguelph.ca

Kemptville Campus
Kemptville, K0G 1J0
Tel 613-258-8336
www.kemptvillec.uoguelph.ca

Ridgetown Campus
Ridgetown, N0P 2C0
Tel 519-674-1500
www.ridgetownc.on.ca

Department of Plant Agriculture
www.plant.uoguelph.ca

Department of Plant Agriculture, Kettleby
1125 Woodchopper's Lane, R.R. #1
Kettleby, L0G 1J0
Tel 905-775-3783

Department of Plant Agriculture, Simcoe
Box 587 Blue Line Rd.
Simcoe, N3Y 4N5
Tel 519-426-7127

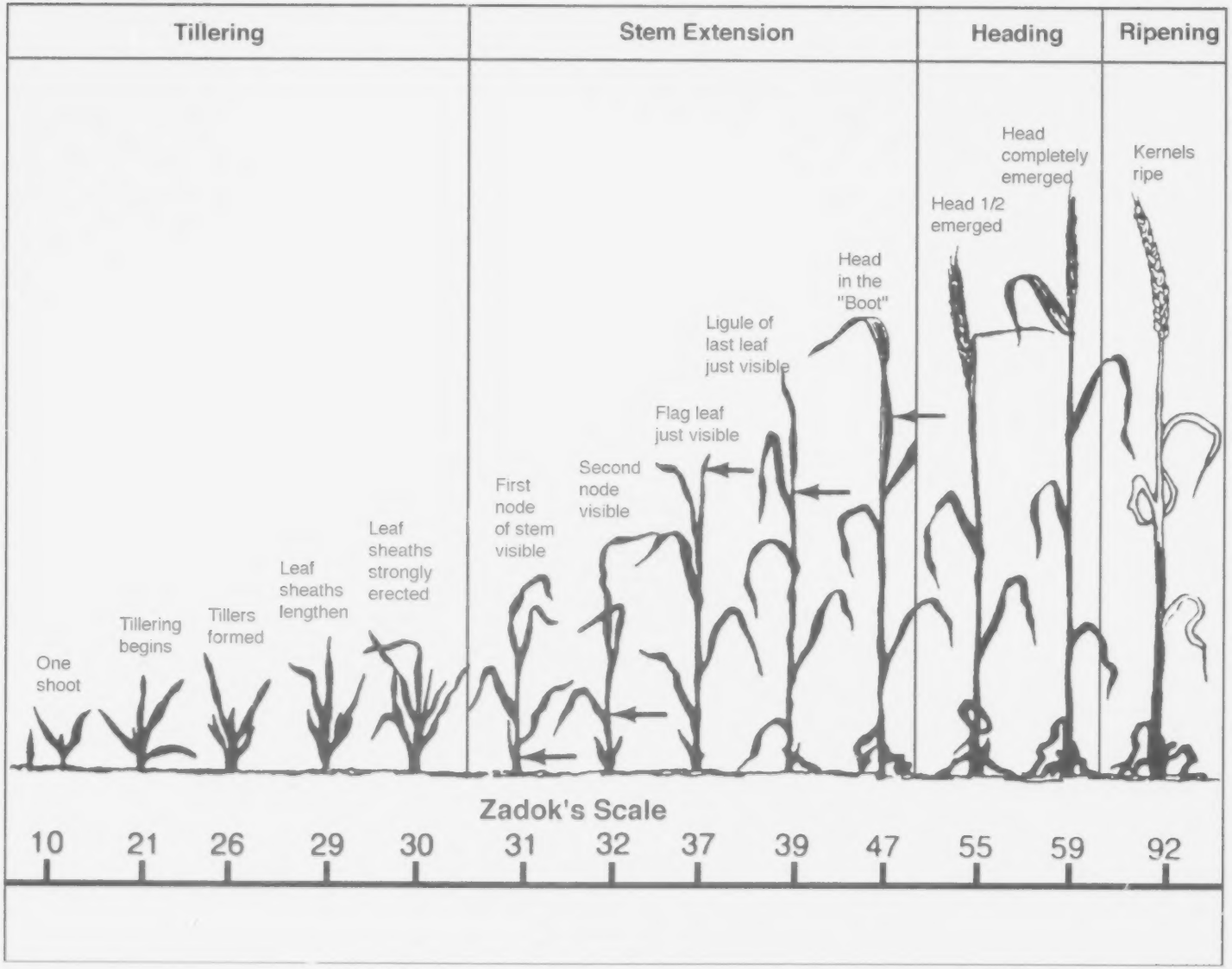
Department of Plant Agriculture, Vineland
Box 7000, 4890 Victoria Ave. N.
Vineland Station, L0R 2E0
Tel 905-562-4141

Lab Services Division
www.uoguelph.ca/labserv/

Pesticide and Trace Contaminants
P.O. Box 3650, 95 Stone Rd. W.
Guelph, N1H 8J7
Tel 519-767-6200

Pest Diagnostic Clinic
Tel 519-767-6256

Appendix G.
Cereal Growth Stages



Appendix H.
Pesticide Groups Based on Sites of Action

Group #	Primary Site of Action	Group Name	Product name (s)	Risk of Developing Resistance
		Insecticides		
	The classification scheme listed below is adapted from the *Insecticide Action Committee Mode of Action Classification* (IRAC) V5.2, September 2006).			
1A[1]	Acetylcholine esterase inhibitors	carbamate	Furadan 480 F, Lannate, Pirimor 50 DF, Sevin XLR, Vydate L	High
1B		organophosphate	Agrox B-2, Agrox CD, Counter 15 G, Cygon 480, Imidan 50 WP, Lagon 480, Lorsban 4E, Lorsban 15 G, Malathion 500 E, Monitor 480, Pyrifos 15 G, Pyrifos 50 W, Pyrinex 480 EC, Thimet 15 G	High
2A	GABA-gated chloride channel agonists	chlorinated cyclodiene	Thiodan 4 EC, Thiodan 50 WP, Thionex 50 W	Mod
3	Sodium channel modulators	diphenylethane	Kelthane 50 W	High
		pyrethroid	Decis 5 EC, Force 3.0 G, Matador 120 EC, Pounce 384 EC, Ripcord 400 EC	
4	Nicotinic acetylcholine receptor agonists	neonicotinoids	Admire, Gaucho 480 FL, Gaucho GS, Poncho 600, Cruiser 5FS, Cruiser 350FS, Helix Xtra, Prosper	Low to Mod
5	Nicotinic acetylcholine receptor agonists (allosteric, not group 4)	naturalyte/spinosyns	Success 480 SC	Low
9B	Compounds of unknown or non-specific mode of action (selective feeding blockers)	pyridines	Fulfill 50 WG	Low
11	Microbial disruptors of insect midgut membranes	biologicals	Bioprotec CAF, Dipex 2X DF, Novodor, Thurcide HPS	Low
17	Chitin biosynthesis inhibitor (diperta only)	cyromazine	Citation 75 WP, Governor 75 WP	Low
21	Mitochondrial complex I electron transport inhibitor	botanicals	Rotenone 5, Rotenone 1% WP, Rotenone 5% WP	Low
24	Mitochondrial complex IV electron transport inhibitors	inorganics	Aluminum phosphide	

[1] Although sharing the same primary target site, it is possible that not all members of a single major mode of action (MoA) class have been shown to be cross-resistant. However, for the purposes of this classification system, it should be assumed that cross-resistance exists between compounds in any one sub-group.

Appendix H.
Pesticide Groups Based on Sites of Action (continued)

Group #	Primary Site of Action	Group Name	Product name (s)	Risk of Developing Resistance
		Fungicides		
		This classification scheme is based on the *Fungicide Resistance Action Committee (FRAC) List*, 2006		
1	Inhibition of mitosis (turbulin formation)	methyl-benzimidazole carbamates	DCT, Senator 70 WP	High
2	Affect cell division, DNA & RNA synthesis & metabolism	dicarboximide	Ronilan EG, Rovral WP	Mod to High
3	DMI (Demethylation Inhibitor): Inhibition of sterol synthesis	triazole	Baytan 30, Bumper 418 EC, Dividend XL RTA, Folicur 432F, Gemini, Quilt, Stratego, Tilt 250 E, Raxil T, Topas 250 E, Helix Xtra	Moderate
4	Phenylamides Affect RNA synthesis	acylamine (phenylamides)	Allegiance FL, Apron FL, Apron XL LS Apron Maxx, Helix Xtra, Prosper	High
5[2]	Inhibition of an isomerase in sterol biosynthesis	morpholines	Acrobat MZ	Low to Mod
7	Fungal respiration	carboxamide anilide	Anchor, Lance WDG, Vitaflo 280, Vitavax RS, Gaucho CS, Prosper	Moderate
11	Fungal respiration: Quinone Outside Inhibitors (QOI)	strobilurin	Cabrio EG, Dynasty 100, Headline EC, Quadris, Quilt, Stratego 250EC, Reason 500 SC, Tanos 50 DF	High
12	Osmotic signal tansduction	phenylpyrroles	Maxim 480 FS, Apron Maxx, Helix Xtra	Low to Mod
14	Lipid peroxidation (proposed)	aromatic hydrocarbon chlorophenyl	Botran 75 W, Quintozene 75 WP	Low to Mod
22	Mitosis and cell division	benzamide	Gavel 75 DF	Low to Mod
25	Protein synthesis	antibiotic	Streptomycin	High
27	Unknown	cyanoacetamide oxime (acetamide)	Curzate 60 DF	Low to Mod
28	Cell membrane permeability (proposed)	carbamate	Tatoo C	Low to Mod
33	Unknown	phosphonate	Aliette WDG	Low
M1	Multi-site, contact	inorganic	Copper Spray, Copper 53 W, Kocide 101 WP, Kocide DF, Microscopic Sulphur, Oxidate, Parasol WP	Low
M2	Multi-site, contact	dithiocarbamate	Anchor, Acrobat MZ, Dithane, Dithane F 45, Ferbam 76 WDG, Gavel 75 DF, Manzate DF, Penncozeb 80, Polyram DF, Ridomil Gold, Thiram 75 WP, Vitaflo 280, Vitavax RS, Zineb 80 W, Gaucho CS, Prosper, Gemini	Low
M3	Multi-site, contact	phthalimide	Agrox B-2, Agrox CD, Captan, DCT, Maestro 75 DF, Supra Captan 80 WDG	Low
M4	Multi-site, contact	chloronitrile	Bravo 500, Tatoo C	Low

[2] Depending on the reference sources, the cinnamic acid group may be listed as a group 5 or group 15.

Appendix I. The Metric System

Metric Units

Linear Measures (length)		
10 millimetres (mm)	=	1 centimetre (cm)
100 centimetres (cm)	=	1 metre (m)
1,000 metres	=	1 kilometre (km)
Square Measures (area)		
100 m X 100 m = 10,000 m^2	=	1 hectare (ha)
100 ha	=	1 square kilometre (km^2)
Cubic Measures (volume)		
Dry Measure		
1,000 cubic millimetres (mm^3)	=	1 cubic centimetre (cm^3)
1,000,000 cm^3	=	1 cubic metre (m^3)
Liquid Measure		
1,000 millilitres (mL)	=	1 litre (L)
100 L	=	1 hectolitre (hL)
Weight-Volume Equivalents (for water)		
(1.00 kg) 1,000 grams	=	1 litre (1.00 L)
(0.50 kg) 500 g	=	500 mL (0.50 L)
(0.10 kg) 100 g	=	100 mL (0.10 L)
(0.01 kg) 10 g	=	10 mL (0.01 L)
(0.001 kg) 1 g	=	1 mL (0.001 L)
Weight Measures		
1,000 milligrams (mg)	=	1 gram (g)
1,000 g	=	1 kilogram (kg)
1,000 kg	=	1 tonne (t)
1 mg/kg	=	1 part per million (ppm)
Dry–Liquid Equivalents		
1 cm^3	=	1 mL
1 m^3	=	1,000 L

Application Rate Conversions

Metric to Imperial (Approximate)

litres per hectare x 0.09	=	gallons per acre
litres per hectare x 0.36	=	quarts per acre
litres per hectare x 0.71	=	pints per acre
millilitres per hectare x 0.015	=	fluid ounces per acre
grams per hectare x 0.015	=	ounces per acre
kilograms per hectare x 0.89	=	pounds per acre
tonnes per hectare x 0.45	=	tons per acre

Imperial to Metric (Approximate)

gallons per acre x 11.23	=	litres per hectare (L/ha)
quarts per acre x 2.8	=	litres per hectare (L/ha)
pints per acre x 1.4	=	litres per hectare (L/ha)
fluid ounces per acre x 70	=	millilitres per hectare (mL/ha)
tons per acre x 2.24	=	tonnes per hectare (t/ha)
pounds per acre x 1.12	=	kilograms per hectare (kg/ha)
ounces per acre x 70	=	grams per hectare (g/ha)

Liquid Equivalents

Litres/Hectare		*Approximate Gallons/Acre*
50	=	5
100	=	10
150	=	15
200	=	20

Dry Weight Equivalents

Grams or Kilograms/Hectare		*Ounces or Pounds/Acre*
100 grams	=	$1^1/_2$ ounces
200 grams	=	3 ounces
300 grams	=	$4^1/_4$ ounces
500 grams	=	7 ounces
700 grams	=	10 ounces
1.10 kilograms	=	1 pound
1.50 kilograms	=	$1^1/_4$ pounds
2.00 kilograms	=	$1^3/_4$ pounds
2.50 kilograms	=	$2^1/_4$ pounds
3.25 kilograms	=	3 pounds
4.00 kilograms	=	$3^1/_2$ pounds
5.00 kilograms	=	$4^1/_2$ pounds
6.00 kilograms	=	$5^1/_4$ pounds
7.50 kilograms	=	$6^3/_4$ pounds
9.00 kilograms	=	8 pounds
11.00 kilograms	=	10 pounds
13.00 kilograms	=	$11^1/_2$ pounds
15.0 kilograms	=	$13^1/_2$ pounds

Metric Conversions

5 mL	=	1 tsp
15 mL	=	1 tbsp
28.5 mL	=	1 fl. oz

Conversion Tables — Metric to Imperial

Length		
1 millimetre (mm)	=	0.04 inch
1 centimetre (cm)	=	0.40 inch
1 metre (m)	=	39.40 inches
1 metre (m)	=	3.28 feet
1 metre (m)	=	1.09 yards
1 kilometre (km)	=	0.62 mile
Area		
1 square centimetre (cm^2)	=	0.16 square inch
1 square metre (m^2)	=	10.77 square feet
1 square metre (m^2)	=	1.20 square yards
1 square kilometre (km^2)	=	0.39 square mile
1 hectare (ha)	=	107,636 square feet
1 hectare (ha)	=	2.5 acres
Volume (dry)		
1 cubic centimetre (cm^3)	=	0.061 cubic inch
1 cubic metre (m^3)	=	1.31 cubic yards
1 cubic metre (m^3)	=	35.31 cubic feet
1,000 cubic metres (m^3)	=	0.81 acre-foot
1 hectolitre (hL)	=	2.8 bushels
Volume (liquid)		
1 millilitre (mL)	=	0.035 fluid ounce
1 litre (L)	=	1.76 pints
1 litre (L)	=	0.88 quart
1 litre (L)	=	0.22 gallon (Imp.)
1 litre (L)	=	0.26 gallon (U.S.)
Weight		
1 gram (g)	=	0.035 ounce
1 kilogram (kg)	=	2.21 pounds
1 tonne (t)	=	1.10 short tons
1 tonne (t)	=	2,205 pounds
Pressure		
1 kilopascal (kPa)	=	0.15 pounds/in^2
Speed		
1 metre per second	=	3.28 feet per second
1 metre per second	=	2.24 miles per hour
1 kilometre per hour	=	0.62 mile per hour
Temperature		
°F	=	(°C X $^9/_5$) + 32

Conversion Tables — Imperial to Metric

Length		
1 inch	=	2.54 cm
1 foot	=	0.30 m
1 yard	=	0.91 m
1 mile	=	1.61 km
Area		
1 square foot	=	0.09 m^2
1 square yard	=	0.84 m^2
1 acre	=	0.40 ha
Volume (dry)		
1 cubic yard	=	0.76 m^3
1 bushel	=	36.37 L
Volume (liquid)		
1 fluid ounce (Imp.)	=	28.41 mL
1 pint (Imp.)	=	0.57 L
1 gallon (Imp.)	=	4.55 L
1 gallon (U.S.)	=	3.79 L
Weight		
1 ounce	=	28.35 g
1 pound	=	453.6 g
1 ton	=	0.91 tonne
Pressure		
1 pound per square inch	=	6.90 kPa
Temperature		
°C	=	(°F – 32) x $^5/_9$

Abbreviations

%	= per cent (by weight)	km	= kilometre
ai	= active ingredient	km/h	= kilometres per hour
AP	= agricultural powder	kPa	= kilopascal
cm	= centimetre	L	= litre
cm^2	= square centimetre	m	= metre
DG	= dispersible granular	m^2	= square metre
DP	= dispersible powder	mL	= millilitre
E	= emulsifiable	mm	= millimetre
e.g.	= for example	m/s	= metres per second
EC	= emulsifiable concentrate	SC	= sprayable concentrate
F	= flowable	SP	= soluble powder
g	= gram	t	= tonne
Gr	= granules, granular	W	= wettable (powder)
ha	= hectare	WDG	= water dispersible granular
kg	= kilogram	WP	= wettable powder

Appendix J. Field Record Form 20__

	Field I.D.				Field I.D.				Field I.D.				Field I.D.			
Acreage																
Soil Type																
	pH	N	P	K	pH	N	P	K	pH	N	P	K	pH	N	P	K
Soil Fertility																
Tillage																
Variety/Hybrid																
Seeding Rate																
Seeding Date																
Seed Treatment																
Fertilizer/Lime product, rate, timing																
Manure Application																
Herbicides																
Rate																
Crop Stage																
Date																
Yield																
Harvest Date																
Moisture																
Test Wt/Grade																
Notes																

Appendix K. Field Scouting Report

Farm: _____ Scout: _____ Date: _____ Time: _____

Field: _____ Acreage: _____ Crop: _____ Plant Population: _____

Crop Growth Stage, Height and Condition:

Soil Condition: _____

Weeds	Growth Stage	Pressure/Density

Insects	Stage	Pressure/ Density

Diseases	Stage	Pressure/Density

Field Map: weed, insect, disease patches, crop condition, including GSP coordinates

Field Scout's Comments: _____

Action Recommended: _____

Emergency and First-Aid Procedures for Pesticide Poisoning

For a major spill, a theft or a fire involving a pesticide call the Ministry of the Environment at **1-800-268-6060.**

For pesticide poisonings and pesticide injuries call the **Poison Information Centre**:

Toronto	1-800-268-9017
Hearing Assistance (TTY)	1-877-750-2233

PREVENT ACCIDENTS

- **Read the label**. Follow all the precautions the label recommends. Read the First Aid section of the label BEFORE you begin to handle any pesticide.
- **Make sure that someone knows** what pesticides you are working with and where you are.
- **Keep a file of labels and product Material Safety Data Sheets (MSDS) for the pesticides you use.** Make sure everyone knows where to find this in case of an emergency.
- **Post emergency numbers near all telephones.**
- **Keep clean water, paper towels, extra gloves and clean coveralls close by** in case you spill pesticide on yourself.

If someone has been working with pesticides and you see any possible symptoms of pesticide poisoning or injury, take emergency action immediately.

IF AN ACCIDENT OR POISONING HAPPENS

- Protect yourself from injury first.
- Stop the exposure to the pesticide. Move the victim away from the contaminated area.
- Check the four basic facts — identify the pesticide, the quantity, the route of entry and time of exposure.
- Call an ambulance or the Poison Information Centre.
- Start first aid. This is **not** a substitute for professional medical help.
- **Provide the label, MSDS sheet or container to emergency personnel** at the scene — or take it with you to the hospital. Do not transport pesticide containers in the passenger compartment of the vehicle.

FIRST AID

If a pesticide comes in contact with skin:

- remove all contaminated clothing; wash skin thoroughly with lots of soap and warm water
- dry skin well and cover with clean clothing or other clean material.

If pesticide comes in contact with eyes:

- hold eyelids open wash the eyes with clean running water for 15 minutes or more.

If pesticide was inhaled:

- move the victim to fresh air and loosen tight clothing
- give artificial respiration if the victim is not breathing.

Do not breathe in the exhaled air from the victim – you could also be poisoned.

If a pesticide was swallowed:

- **call the Poison Information Centre IMMEDIATELY.**

Emergency numbers are listed at the front of each Bell telephone directory.

For information, or to obtain copies of this or any other ministry publication please: call 1-888-466-2372 from within Ontario,

519-826-3700 from outside the province or OMAFRA's TTY line at 519-826-7402 for the hearing impaired, email your request to *products.omafra@ontario.ca*, or visit OMAFRA's website at *www.ontario.ca/omafra*.

A complete list of all OMAFRA products and services, and order forms, are available on the website. Orders can be faxed to 519-826-3633 or mailed to ServiceOntario, 1 Stone Road West, Guelph, Ontario N1G 4Y2.

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